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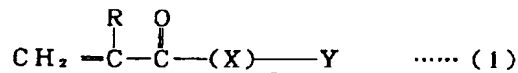
(54)【発明の名称】 農園芸用保水材

(57)【要約】

【課題】 吸液倍率が高く、従って保水性に優れ、かつ、植物の根に対する親和性に優れた農園芸用保水材を提供する。

【解決手段】 農園芸用保水材は、アニオン性単量体、および一般式(1)

【化4】

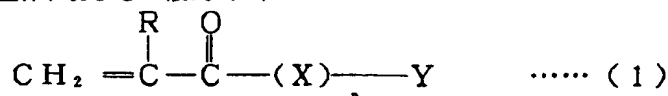


(式中、Rは水素原子またはメチル基を表し、Xは全オキシアルキレン基に対するオキシエチレン基のモル分率が50モル%以上である炭素数2～4のオキシアルキレン基を表し、Yは炭素数1～5のアルコキシ基、フェノキシ基、または置換基として炭素数1～9のアルキル基を1～3個有するオキシアルキルフェニル基を表し、nは平均で3～100の整数を表す)で表されるノニオン性単量体を含む単量体成分から導かれる架橋共重合体のアルカリ土類金属塩を含む。アニオン性単量体は、メタクリル酸が特に好ましい。ノニオン性単量体は、メトキシポ

リエチレングリコールメタクリレートが特に好ましい。アルカリ土類金属は、カルシウムがより好ましい。

## 【特許請求の範囲】

【請求項 1】アニオン性単量体、および一般式 (1)



(式中、Rは水素原子またはメチル基を表し、Xは全オキシアルキレン基に対するオキシエチレン基のモル分率が50モル%以上である炭素数2～4のオキシアルキレン基を表し、Yは炭素数1～5のアルコキシ基、フェノキシ基、または置換基として炭素数1～9のアルキル基を1～3個有するオキシアルキルフェニル基を表し、nは平均で3～100の整数を表す)で表されるノニオン性単量体を含む単量体成分から導かれる架橋共重合体のアルカリ土類金属塩を含むことを特徴とする農園芸用保水材。

【請求項 2】アルカリ土類金属がカルシウムであることを特徴とする請求項 1 記載の農園芸用保水材。

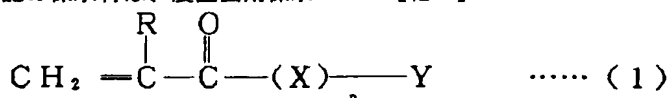
【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、例えば、砂漠の緑化や、土壌の砂漠化の防止等の環境保全、或いは、家庭菜園等に好適に供される農園芸用保水材に関するものである。

【0002】

【従来の技術】従来より、アクリルアミド系ポリマー等のノニオン型ポリマー、或いはアクリル酸系ポリマー等のアニオン型ポリマーからなる保水材が知られている。ところが、ノニオン型ポリマーは、植物の根に対して高い親和性を有するものの、吸液倍率が低く、保水性に劣るという欠点を有している。また、アニオン型ポリマーは、吸液倍率が高く、保水性に優れたものの、植物の根に対する親和性に劣り、発芽や発根、生長等を阻害する等の悪影響を及ぼすので、植物が枯れ易いという欠点を有している。このため、上記の保水材は、農園芸用保水



【0009】(式中、Rは水素原子またはメチル基を表し、Xは全オキシアルキレン基に対するオキシエチレン基のモル分率が50モル%以上である炭素数2～4のオキシアルキレン基を表し、Yは炭素数1～5のアルコキシ基、フェノキシ基、または置換基として炭素数1～9のアルキル基を1～3個有するオキシアルキルフェニル基を表し、nは平均で3～100の整数を表す)で表されるノニオン性単量体を含む単量体成分から導かれる架橋共重合体のアルカリ土類金属塩を含むことを特徴としている。

【0010】請求項 2 記載の発明の農園芸用保水材は、

【化 1】

材として供するのに不適である。

【0003】そこで、アニオン性単量体およびノニオン性単量体を含む単量体成分から導かれる架橋共重合体からなる農園芸用保水材が提案されている(特公平3-8736号公報、特開平3-149288号公報)。

【0004】

【発明が解決しようとする課題】しかしながら、上記従来の農園芸用保水材においても、保水性と、植物の根に対する親和性とのバランスが不充分であり、両者を満足する性能を備えていると言い難い。従って、保水性に優れ、かつ、植物の根に対する親和性に優れた農園芸用保水材が切望されている。

【0005】本発明は、上記従来の問題点に鑑みなされたものであり、その目的は、保水性に優れ、かつ、植物の根に対する親和性に優れた農園芸用保水材を提供することにある。

【0006】

【課題を解決するための手段】本願発明者等は、上記の目的を達成すべく鋭意検討した結果、アニオン性単量体および特定の構造のノニオン性単量体を含む単量体成分から導かれる架橋共重合体のアルカリ土類金属塩を含む農園芸用保水材が、吸液倍率が高く、従って保水性に優れ、しかも、植物の根に対して高い親和性を有していることを見い出して、本発明を完成させるに至った。

【0007】即ち、請求項 1 記載の発明の農園芸用保水材は、上記の課題を解決するために、アニオン性単量体、および一般式 (1)

【0008】

【化 2】

上記の課題を解決するために、請求項 1 記載の農園芸用保水材において、アルカリ土類金属がカルシウムであることを特徴としている。

【0011】上記の構成によれば、農園芸用保水材は、アニオン性単量体および特定の構造のノニオン性単量体を含む単量体成分から導かれる架橋共重合体のアルカリ土類金属塩を含んでいる。これにより、吸液倍率が高く、従って保水性に優れ、かつ、植物の根に対する親和性に優れた農園芸用保水材を提供することができる。

【0012】以下に本発明を詳しく説明する。本発明にかかる農園芸用保水材は、アニオン性単量体および特定

の構造のノニオン性単量体を含む単量体成分から導かれる架橋共重合体のアルカリ土類金属塩を含んでいる。上記のアルカリ土類金属は、マグネシウムおよびカルシウムがより好ましく、カルシウムが特に好ましい。尚、上記の単量体成分は、農園芸用保水材としての性能を損なわない範囲内で、アニオン性単量体およびノニオン性単量体以外の他の単量体を含んでいてもよい。

【0013】上記のアニオン性単量体は、後述の如くアルカリ土類金属と塩を形成可能な単量体であればよく、特に限定されるものではない。アニオン性単量体としては、具体的には、例えば、(メタ)アクリル酸、クロトン酸等の不飽和モノカルボン酸系単量体およびこれらのアルカリ金属塩；マレイン酸、フマル酸、イタコン酸、シトラコン酸等の不飽和ジカルボン酸系単量体およびこれらのアルカリ金属塩；ビニルスルホン酸、アリルスルホン酸、メタリルスルホン酸、ステレンスルホン酸、2-アクリルアミド-2-メチルプロパンスルホン酸、スルホエチル(メタ)アクリレート、スルホプロピル(メタ)アクリレート、2-ヒドロキシスルホプロピル(メタ)アクリレート等の不飽和スルホン酸系単量体およびこれらのアルカリ金属塩；(メタ)アクリルアミドメタンホスホン酸、2-(メタ)アクリルアミド-2-メチルプロパンホスホン酸等の不飽和ホスホン酸系単量体およびこれらのアルカリ土類金属塩等が挙げられる。これらアニオン性単量体は、単独で用いてもよく、また、二種類以上を適宜混合して用いてもよい。上記例示の単量体のうち、不飽和モノカルボン酸系単量体およびこれらのアルカリ土類金属塩がより好ましく、(メタ)アクリル酸およびこれらのアルカリ土類金属塩がさらに好ましく、メタクリル酸およびそのアルカリ土類金属塩が特に好ましい。尚、アニオン性単量体は、得られる農園芸用保水材の吸液倍率を向上させると共に、該農園芸用保水材に適度なゲル強度を付与する機能を有している。そして、農園芸用保水材は、適度なゲル強度を有することにより、土壤中で膨潤して空隙を形成し、該土壤に通気性を付与するようになっている。

【0014】前記一般式(1)で表されるノニオン性単量体としては、具体的には、例えば、メトキシポリエチレングリコールモノ(メタ)アクリレート、エトキシポリエチレングリコールモノ(メタ)アクリレート、ブトキシポリエチレングリコールモノ(メタ)アクリレート、メトキシポリエチレングリコール・ポリプロピレングリコールモノ(メタ)アクリレート、メトキシポリエチレングリコール・ポリブチレングリコールモノ(メタ)アクリレート、エトキシポリエチレングリコール・ポリプロピレングリコールモノ(メタ)アクリレート、エトキシポリエチレングリコール・ポリブチレングリコールモノ(メタ)アクリレート、フェノキシポリエチレングリコールモノ(メタ)アクリレート、ベンジルオキシポリエチレングリコールモノ(メタ)アクリレート等

の(メタ)アクリル酸エステル系単量体が挙げられる。これらノニオン性単量体は、単独で用いてもよく、また、二種類以上を適宜混合して用いてもよい。上記例示の単量体のうち、メトキシポリエチレングリコールメタクリレートがより好ましい。また、ノニオン性単量体としてメトキシポリエチレングリコールメタクリレートをを用いる場合には、エチレンオキサイドの平均付加モル数は5モル～50モルの範囲内が好ましい。つまり、一般式(1)におけるXがオキシエチレン基であり、Rがメチル基であり、Yがメトキシ基である場合には、nは5～50の範囲内が好ましい。尚、ノニオン性単量体におけるポリオキシアルキレン鎖は、得られる農園芸用保水材の植物の根に対する親和性、および、該農園芸用保水材の耐塩性等を向上させる機能を有している。

【0015】上記のアニオン性単量体とノニオン性単量体との比、つまり、架橋共重合体成分におけるアニオン性単量体の割合は、特に限定されるものではないが、5重量%～95重量%の範囲内がより好ましく、10重量%～70重量%の範囲内がさらに好ましい。アニオン性単量体の割合が5重量%よりも少ない場合には、架橋共重合体のアルカリ土類金属塩の吸液倍率が低くなる。また、得られる農園芸用保水材のゲル強度が低下し、土壤に通気性を付与することができなくなる。アニオン性単量体の割合が95重量%よりも多い場合には、得られる架橋共重合体における溶出成分(可溶成分)が多くなる傾向がある。また、得られる農園芸用保水材の植物の根に対する親和性、および、該農園芸用保水材の耐塩性が低下する。従って、所望する物性を備えた農園芸用保水材が得られないおそれがある。

【0016】架橋共重合体のアルカリ土類金属塩を製造する方法は、特に限定されるものではなく、例えば、①アニオン性単量体と、塩化カルシウムや塩化マグネシウム等の塩化物とを反応させてアニオン性単量体のアルカリ土類金属塩を形成した後、ノニオン性単量体を添加して共重合させる方法、②アニオン性単量体と、水酸化カルシウムや水酸化マグネシウム等の水酸化物とを反応させてアニオン性単量体のアルカリ土類金属塩を形成した後、ノニオン性単量体を添加して共重合させる方法、③アニオン性単量体と、炭酸カルシウムや炭酸マグネシウム等の炭酸塩とを反応させてアニオン性単量体のアルカリ土類金属塩を形成した後、ノニオン性単量体を添加して共重合させる方法、④アニオン性単量体とノニオン性単量体とを共重合させた後、上記の塩化物を添加してアルカリ土類金属塩を形成する方法、⑤アニオン性単量体とノニオン性単量体とを共重合させた後、上記の水酸化物を添加してアルカリ土類金属塩を形成する方法、⑥アニオン性単量体とノニオン性単量体とを共重合させた後、上記の炭酸塩を添加してアルカリ土類金属塩を形成する方法等の種々の方法を採用することができる。また、アニオン性単量体と、ノニオン性単量体と、上記の

塩化物、水酸化物または炭酸塩とを混合した後、共重合させて架橋共重合体のアルカリ土類金属塩を製造することもできる。これら方法のうち、②の方法～⑥の方法がより好ましく、④の方法～⑥の方法がさらに好ましく、④の方法が特に好ましい。また、上記④の方法を採用する場合には、塩化物は塩化カルシウムが特に好ましい。

【0017】さらに、架橋共重合体のアルカリ金属塩を一旦形成した後、該アルカリ金属塩をアルカリ土類金属塩に置換することにより、架橋共重合体のアルカリ土類金属塩を製造することもできる。この場合、アニオン性単量体のアルカリ金属塩と、ノニオン性単量体とを共重合させて架橋共重合体のアルカリ金属塩を形成することにより、架橋共重合体の分子量をより一層大きくすることができる。尚、アルカリ金属は、ナトリウムがより好ましい。

【0018】本願発明における架橋共重合体のアルカリ土類金属塩が、例えばナトリウム塩やカリウム塩等のアルカリ金属塩と比べて、溶出成分が少なくなる理由については明確ではないが、次のように推察される。即ち、溶出成分は、可溶性ポリマーを主成分とするが、該可溶性ポリマーがアルカリ土類金属により、二次元的或いは三次元的に架橋される結果、可溶性ポリマーの溶解性が低下するためであると推察される。

【0019】重合方法は、従来公知の種々の方法、例えば、溶液重合法、懸濁重合法、逆相懸濁重合法、或いは注型重合法、薄膜重合法、噴霧重合法等を採用することができる。尚、重合反応を行なう際の攪拌方法は、特に限定されるものではないが、双腕型ニーダーを攪拌装置として用い、生成するゲル状の架橋共重合体（後述する）を該双腕型ニーダーの剪断力によって細分化しながら攪拌することがより好ましい。

【0020】逆相懸濁重合法を採用する場合に好適な分散剤としては、具体的には、例えば、ソルビタン脂肪酸エステル、ショ糖脂肪酸エステル、グリセリン脂肪酸エステル、ポリグリセリン脂肪酸エステル、エチルセルローズやセルロースアセテート等のセルロースエステル、セルロースエーテル、 $\alpha$ -オレフィン-無水マレイン酸共重合体等のカルボキシル基含有重合体等が挙げられる。これら分散剤は、単独で用いてもよく、また、二種類以上を適宜混合して用いてもよい。尚、逆相懸濁重合法を採用する場合に供される疎水性有機溶媒は、特に限定されるものではない。

【0021】反応温度は、特に限定されるものではないが、比較的低温の方が架橋共重合体の分子量が大きくなるので好ましく、20℃～100℃の範囲内が重合反応が完結するのでさらに好ましい。尚、反応時間は、上記重合反応が完結するように、反応温度や、単量体成分、重合開始剤、および溶媒等の種類（性質）や組み合わせ、使用量等に応じて、適宜設定すればよい。

【0022】単量体成分を共重合させる際には、重合開

始剤を用いることができる。該重合開始剤としては、具体的には、例えば、過酸化水素、ベンゾイルパーオキサイド、キュメンヒドロパーオキサイド等の過氧化物；

2,2'-アゾビスイソブチロニトリル、2,2'-アゾビス（2-アミノプロパン）塩酸塩等のアゾ化合物；過硫酸アンモニウム、過硫酸ナトリウム、過硫酸カリウム等の過硫酸塩等のラジカル発生剤（ラジカル重合開始剤）等が挙げられる。これら重合開始剤は、単独で用いてもよく、また、二種類以上を適宜混合して用いてもよい。さらに、これらラジカル発生剤と、亜硫酸水素ナトリウムやL-アスコルビン酸（塩）、第一鉄塩等の還元剤とを組み合わせるレドックス系開始剤を用いてもよい。尚、重合開始剤を用いる代わりに、放射線や電子線、紫外線等を照射してもよく、また、重合開始剤とこれら放射線や電子線、紫外線等の照射とを併用してもよい。

【0023】重合開始剤の使用量は、特に限定されるものではないが、単量体成分に対して0.001重量%～10重量%の範囲内がより好ましく、0.01重量%～1重量%の範囲内がさらに好ましい。また、レドックス系開始剤を用いる場合における還元剤の使用量は、特に限定されるものではないが、ラジカル発生剤に対して重量比で0.01～5の範囲内がより好ましく、0.05～2の範囲内がさらに好ましい。

【0024】また、単量体成分を共重合させる際には、必要に応じて架橋剤を用いてもよい。該架橋剤としては、具体的には、例えば、ジビニルベンゼン、エチレングリコールジ（メタ）アクリレート、ジエチレングリコールジ（メタ）アクリレート、トリエチレングリコールジ（メタ）アクリレート、プロピレングリコールジ（メタ）アクリレート、ポリエチレングリコールジ（メタ）アクリレート、トリメチロールプロパントリ（メタ）アクリレート、ペンタエリスリトールジ（メタ）アクリレート、ペンタエリスリトールトリ（メタ）アクリレート、N,N-メチレンビス（メタ）アクリルアミド、イソシアヌル酸トリアルル、トリメチロールプロパンジアリルエーテル等の、1分子中にエチレン系不飽和基を2個以上有する化合物；エチレングリコール、ジエチレングリコール、トリエチレングリコール、ポリエチレングリコール、グリセリン、ポリグリセリン、プロピレングリコール、ポリプロピレングリコール、ポリビニルアルコール、ペンタエリスリトール、ジエタノールアミン、トリエタノールアミン、ソルビット、ソルビタン、グルコース、マンニット、マンニタン、ショ糖、ブドウ糖等の多価アルコール；エチレングリコールジグリシジルエーテル、ポリエチレングリコールジグリシジルエーテル、グリセリンジグリシジルエーテル、プロピレングリコールジグリシジルエーテル、ポリプロピレングリコールジグリシジルエーテル、ネオペンチルグリコールジグリシジルエーテル、1,6-ヘキサジオールジグリシジルエーテル、トリメチロールプロパンジグリシジルエーテル、ト

リメチロールプロパントリグリシジルエーテル、グリセリントリグリシジルエーテル等のポリエポキシ化合物等が挙げられる。これら架橋剤は、単独で用いてもよく、また、二種類以上を適宜混合して用いてもよい。

【0025】架橋剤を用いることにより、架橋共重合体の架橋密度を制御することができるので、農園芸用保水材の保水能（例えば、吸液倍率等）を調節することができる。架橋剤の使用量は、特に限定されるものではなく、例えば、用いる単量体成分や架橋剤の種類、所望する架橋密度（つまり、保水能）やゲル強度等によって適宜設定すればよい。具体的には、架橋剤の使用量は、単量体成分に対するモル比が凡そ0.0005～0.02の範囲内がより好ましく、0.001～0.01の範囲内がさらに好ましい。尚、架橋剤として多価アルコールを用いる場合には、重合反応後、架橋共重合体を150℃～250℃で加熱処理することが好ましい。また、架橋剤としてポリエポキシ化合物を用いる場合には、重合反応後、架橋共重合体を50℃～250℃で加熱処理することが好ましい。

【0026】さらに、単量体成分を共重合させる際には、必要に応じて溶媒を用いてもよい。該溶媒としては、具体的には、例えば、水；シクロヘキサン、トルエン；メタノール、エタノール、アセトン、ジメチルホルムアミド、ジメチルスルホキシド等の水性溶媒等が挙げられる。これら溶媒は、単独で用いてもよく、また、二種類以上を適宜混合して用いてもよい。上記例示の溶媒のうち、水、および、水と水性溶媒との混合物が、安全性や植物の根に対する親和性等がより一層高い架橋共重合体、即ち、農園芸用保水材を安価に製造することができるので、より好ましい。尚、溶媒を用いる場合における単量体成分の濃度は、特に限定されるものではないが、20重量%～80重量%の範囲内がより好ましく、30重量%～60重量%の範囲内がさらに好ましい。該単量体成分や重合開始剤、架橋剤等を含む溶液における単量体成分の濃度を上記の範囲内とすることにより、重合反応を容易に制御することができると共に、架橋共重合体の収率を向上させることができ、該架橋共重合体を経済的に得ることができる。

【0027】架橋共重合体のアルカリ土類金属塩は、重合反応後、通常はゲル状で得られるので、該ゲル状の架橋共重合体のアルカリ土類金属塩をそのまま、或いは、必要に応じて洗浄や解砕等の所定の操作を行なった後、乾燥させる。乾燥温度は、特に限定されるものではないが、50℃～180℃の範囲内が好適であり、100℃～170℃の範囲内が最適である。また、乾燥物は、粉碎等の操作を行なって細粒化した後、必要に応じてふるい分け等の分級操作を行なう。架橋共重合体のアルカリ土類金属塩の吸液倍率としては、消石灰の飽和水溶液に対する吸液倍率（後述する）が5 g/g～70 g/gの範囲内、好ましくは10 g/g～50 g/gの範囲内であることが好適である。吸液倍率が5 g/g未満の場合は、保水性が不十分となる

おそれがある。また、吸液倍率が70 g/gを越える場合は、耐久性に劣る傾向がある。尚、農園芸用保水材の形状や平均粒子径等は、特に限定されるものではない。

【0028】さらに、架橋共重合体、即ち、農園芸用保水材に残留する未反応の単量体成分を減少させることにより溶出成分を低減させて、該農園芸用保水材の安全性等をより一層向上させるために、ゲル状の架橋共重合体のアルカリ土類金属塩、または、その乾燥物を、還元剤を用いて処理することが好ましい。上記の還元剤としては、具体的には、例えば、亜硫酸ナトリウム、亜硫酸カリウム、亜硫酸アンモニウム、亜硫酸水素ナトリウム、亜硫酸水素カリウム、亜硫酸水素アンモニウム、チオ硫酸ナトリウム、チオ硫酸カリウム、チオ硫酸アンモニウム、L-アスコルビン酸、アンモニア、モノエタノールアミン、グルコース等が挙げられる。これら還元剤は、単独で用いてもよく、また、二種類以上を適宜混合して用いてもよい。上記例示の還元剤のうち、亜硫酸ナトリウム、亜硫酸水素ナトリウム、およびチオ硫酸ナトリウムがより好ましい。還元剤の使用量は、特に限定されるものではないが、具体的には、用いた単量体成分に対するモル比が凡そ0.0001～0.02の範囲内がより好ましく、0.001～0.01の範囲内がさらに好ましい。

【0029】本発明にかかる農園芸用保水材は、例えば、土等の土壌に対して0.01重量%～20重量%の範囲内で混合して使用することが望ましい。農園芸用保水材の使用量が0.01重量%よりも少ない場合には、該農園芸用保水材を用いることによる効果が発現され難い。一方、20重量%を越えて農園芸用保水材を使用しても、上記の範囲内で該農園芸用保水材を用いることによって得られる効果と殆ど変わらないので不経済である。また、土壌が必要以上に水分を保持することになるので、通気性が損なわれ、植物がいわゆる根腐れを引き起こすおそれがある。

【0030】また、農園芸用保水材を使用する際には、そのまま土壌と混合してもよく、また、水や液体肥料を吸収させた後、土壌と混合してもよい。或いは、土や砂、堆肥等の無機若しくは有機粉体と農園芸用保水材とを混合した後、該混合物を土壌と混合してもよい。尚、土壌に対する農園芸用保水材の混合方法は、特に限定されるものではなく、例えば、土壌に農園芸用保水材を均一に撒布する方法；土壌に農園芸用保水材を撒布した後、土壌を耕して混合する方法等を採用することができる。

【0031】本発明にかかる農園芸用保水材は、以上のように、アニオン性単量体、および前記一般式（1）で表されるノニオン性単量体を含む単量体成分から導かれる架橋共重合体のアルカリ土類金属塩を含む構成である。また、農園芸用保水材は、以上のように、アルカリ土類金属がカルシウムである構成である。

【0032】これにより、吸液倍率が高く、従って保水

性に優れ、かつ、植物の根に対する親和性に優れた農園芸用保水材を提供することができる。農園芸用保水材は、根に対する水分の供給を円滑に行うことができ、しかも、発芽や発根、生長等を阻害することがない。また、農園芸用保水材は、液体肥料の保液能にも優れる。さらに、本発明にかかる農園芸用保水材は、例えば、塩の含有量が比較的高い土壌に配合して使用した場合においても、高い吸液倍率を維持することができ、しかも、経時的に安定した保水能を示す。該農園芸用保水材は、例えば、砂漠の緑化や、土壌の砂漠化の防止等の環境保全等に好適に供される。

#### 【0033】

【実施例】以下、実施例および比較例により、本発明をさらに詳細に説明するが、本発明はこれらにより何ら限定されるものではない。尚、架橋共重合体の吸液倍率は、以下の方法で測定した。また、実施例および比較例に記載の「部」は、「重量部」を示している。

#### 【0034】(a) 架橋共重合体の吸液倍率

まず、消石灰の飽和水溶液を調製した。即ち、イオン交換水 100部に消石灰10部を添加し、液温を20℃に調節した後、3時間攪拌した。次に、液温を20℃に維持しながら、該水溶液を濾紙(No. 2)を用いて濾過した。これにより、消石灰の飽和水溶液を調製した。尚、該飽和水溶液は、20℃で保存した。

【0035】次に、架橋共重合体約1gをティーバッグ式袋に均一に入れ、上記の飽和水溶液中に浸漬した。20℃で24時間静置後にティーバッグ式袋を引き上げ、一定時間水切りを行なった後、ティーバッグ式袋の重量 $W_1$ (g)を測定した。また、同様の操作を架橋共重合体を用いないで行ない、そのときのティーバッグ式袋の重量 $W_0$ (g)を測定した。そして、これら重量 $W_1$ ・ $W_0$ から、次式、

吸液倍率(g/g) = (重量 $W_1$ (g) - 重量 $W_0$ (g)) / 架橋共重合体の重量(g)

に従って吸液倍率(g/g)を算出した。尚、この吸液倍率は平衡値である。

【0036】【実施例1】温度計、窒素ガス吹き込み管、および攪拌機を備えた内容積 600mlのプラスチック製の反応器に、アニオン性単量体としての43重量%メタクリル酸ナトリウム水溶液 178.0部、ノニオン性単量体としてのメトキシポリエチレングリコールメタクリレート 163.4部、溶媒としてのイオン交換水53.9部、および、架橋剤としてのポリエチレングリコールジアクリレート0.25部を仕込んで反応液とした。上記のメトキシポリエチレングリコールメタクリレートにおけるエチレンオキシドの平均付加モル数は9モルである。また、ポリエチレングリコールジアクリレートにおけるエチレンオキシドの平均付加モル数は8モルである。

【0037】つまり、メタクリル酸ナトリウム水溶液中のメタクリル酸成分と、メトキシポリエチレングリコー

ルメタクリレートとのモル比が、67:33となるようにすると共に、反応液における上記メタクリル酸成分とメトキシポリエチレングリコールメタクリレートとの合計の濃度、即ち、単量体成分の濃度が、60重量%となるように両者を仕込んだ。また、ポリエチレングリコールジアクリレートを、上記の単量体成分に対する割合が0.05モル%となるように仕込んだ。

【0038】次に、上記の反応液に窒素ガスを吹き込んで溶存酸素を追いつくすと共に、反応系を窒素ガス置換した。続いて、水浴を用いて反応液の温度を40℃に昇温した後、重合開始剤としての10重量% 2,2'-アゾビス(2-アミジノプロパン)塩酸塩(和光純薬工業株式会社製; 商品名 V-50)水溶液 4.3部を添加した。そして、該反応液を攪拌・混合した後、攪拌を停止した。すると、直ちに重合反応が開始された。2,2'-アゾビス(2-アミジノプロパン)塩酸塩は、単量体成分に対する割合が0.15モル%となるように添加した。

【0039】上記の重合反応においては、反応を開始してから 107分後に反応液の温度が88℃になり、ピークに達した。この間、水浴の温度は、反応液の温度とほぼ等しくなるように適宜昇温させた。反応液の温度がピークに達した後、水浴の温度を80℃に維持し、該反応液を60分間熟成した。反応終了後、得られた含水ゲル状重合体を取り出し、微粒子状に解砕した。

【0040】解砕した含水ゲル状重合体を、熱風循環式乾燥機を用いて窒素気流下、150℃で1時間乾燥した後、乾燥物を卓上型粉碎機を用いて粉碎し、架橋共重合体のナトリウム塩を得た。得られた架橋共重合体(ナトリウム塩)の吸液倍率を上記の方法により測定した。その結果、吸液倍率は20.9 g/gであった。また、該架橋共重合体は、1g当たり、2.95ミリモル(当量)のアニオン性官能基を有していた。

【0041】次に、上記架橋共重合体のナトリウム塩をマグネシウム塩(アルカリ土類金属塩)に置換した。即ち、無水塩化マグネシウム 0.281g(2.95ミリモル)をイオン交換水10gに溶解してなる水溶液を該架橋共重合体1gに添加した後、50℃で1時間静置した。これにより、含水ゲルを得た。次いで、該含水ゲルに全量が1000gとなるようにイオン交換水を混合し、1時間攪拌した後、濾過(1回目)した。

【0042】得られた濾液(含水ゲル)に全量が1000gとなるようにイオン交換水を混合し、1時間攪拌した後、濾過(2回目)し、さらに、この濾液に全量が1000gとなるようにイオン交換水を混合し、1時間攪拌した後、濾過(3回目)した。次いで、3回目の濾過により得られた濾液(含水ゲル)を減圧乾燥した後、乾燥物を卓上型粉碎機を用いて粉碎した。これにより、粉末状の架橋共重合体のマグネシウム塩を得た。

【0043】得られた架橋共重合体がナトリウム塩からマグネシウム塩に置換されていることは、以下のように

して確認した。即ち、上記 1 回目および 2 回目の濾過により得られた濾液には、合計で、マグネシウムイオンが 1.48 ミリモル、ナトリウムイオンが 2.97 ミリモル含まれていた。また、上記 3 回目の濾過により得られた濾液には、マグネシウムイオン並びにナトリウムイオンは含まれていなかった。従って、塩の形成に供されていたナトリウムイオンは濾液に溶出したことがわかった。また、塩の形成に供されたマグネシウムイオンは 1.47 ミリモルであることがわかった。そして、ナトリウムが一価金属、マグネシウムが二価金属であり、かつ、架橋共重合体が 2.95 ミリモル/g のアニオン性官能基を有していることから、塩の形成に供されたマグネシウムイオンのモル数は、理論値と一致していることがわかった。これにより、架橋共重合体がナトリウム塩からマグネシウム塩に置換されていることを確認した。

【0044】得られた架橋共重合体（マグネシウム塩）、即ち、農園芸用保水材の吸液倍率を上記の方法により測定した。その結果、吸液倍率は 15.9 g/g であった。農園芸用保水材の製造時の主な条件と共に、吸液倍率を表 1 に記載した。

【0045】次に、上記農園芸用保水材の性能を評価した。即ち、川砂（土壌）150 部に、上記の農園芸用保水材 0.15 部、および消石灰 5 部を混合し、該混合物（以下、単に川砂と称す）を所定の育苗箱に均一に入れた。次いで、上記の川砂に、育苗箱から水が流れ出すまで、水道水を滴下（灌水）した。その後、川砂に、二十日大根の種子（株式会社トーホク製；品名 チェリーメイト）50 粒を播種した。そして、播種後、灌水を行うことなく、散光を当てながら所定の条件下で該育苗箱を放置した。

【0046】その結果、播種してから 3 日目における種子の発芽率（以下、単に発芽率と記す）は 88% であった。また、播種してから 10 日目における二十日大根の生育状況（以下、単に生育状況と記す）を目視にて評価したところ、良好であった。尚、上記の発芽率は、次式、 $\text{発芽率}(\%) = (\text{発芽した種子の数} / \text{播種した種子の数}) \times 100$

に基づいて算出した。これら評価結果を、表 3 に記載した。

【0047】〔実施例 2〕先ず、実施例 1 と同様の反応および操作を行ない、架橋共重合体のナトリウム塩を得た。次いで、実施例 1 における無水塩化マグネシウム 0.281 g（2.95 ミリモル）に代えて、無水塩化カルシウム 0.327 g（2.95 ミリモル）を用いた以外は、実施例 1 と同様の操作を行ない、架橋共重合体のカルシウム塩を得た。得られた架橋共重合体（カルシウム塩）、即ち、農園芸用保水材の吸液倍率は 21.0 g/g であった。農園芸用保水材の製造時の主な条件と共に、吸液倍率を表 1 に記載した。

【0048】次に、上記農園芸用保水材の性能を実施例

1 と同様の条件下にて評価した。その結果、発芽率は 100% であった。また、生育状況は良好であった。これら評価結果を、表 3 に記載した。

【0049】〔実施例 3〕実施例 1 における、43 重量% メタクリル酸ナトリウム水溶液およびメトキシポリエチレングリコールメタクリレート（仕込み量を変更して、メタクリル酸ナトリウム水溶液中のメタクリル酸成分と、メトキシポリエチレングリコールメタクリレートとのモル比が、5 : 95 となるようにした以外は、実施例 1 と同様の条件下で反応および操作を行ない、架橋共重合体のナトリウム塩を得た。次いで、実施例 2 と同様の操作を行ない、架橋共重合体のカルシウム塩を得た。得られた架橋共重合体（カルシウム塩）、即ち、農園芸用保水材の吸液倍率は 17.2 g/g であった。農園芸用保水材の製造時の主な条件と共に、吸液倍率を表 1 に記載した。

【0050】次に、上記農園芸用保水材の性能を実施例 1 と同様の条件下にて評価した。その結果、発芽率は 92% であった。また、生育状況は良好であった。これら評価結果を、表 3 に記載した。

【0051】〔実施例 4〕実施例 1 における、43 重量% メタクリル酸ナトリウム水溶液およびメトキシポリエチレングリコールメタクリレート（仕込み量を変更して、メタクリル酸ナトリウム水溶液中のメタクリル酸成分と、メトキシポリエチレングリコールメタクリレートとのモル比が、95 : 5 となるようにした以外は、実施例 1 と同様の条件下で反応および操作を行ない、架橋共重合体のナトリウム塩を得た。次いで、実施例 2 と同様の操作を行ない、架橋共重合体のカルシウム塩を得た。得られた架橋共重合体（カルシウム塩）、即ち、農園芸用保水材の吸液倍率は 5.4 g/g であった。農園芸用保水材の製造時の主な条件と共に、吸液倍率を表 1 に記載した。

【0052】次に、上記農園芸用保水材の性能を実施例 1 と同様の条件下にて評価した。その結果、発芽率は 94% であった。また、生育状況は良好であった。これら評価結果を、表 3 に記載した。

【0053】〔実施例 5〕実施例 1 における、43 重量% メタクリル酸ナトリウム水溶液、およびエチレンオキサイドの平均付加モル数が 9 モルであるメトキシポリエチレングリコールメタクリレートに代えて、43 重量% アクリル酸ナトリウム水溶液、およびエチレンオキサイドの平均付加モル数が 23 モルであるメトキシポリエチレングリコールメタクリレートを用い、かつ、アクリル酸ナトリウム水溶液中のアクリル酸成分と、メトキシポリエチレングリコールメタクリレートとのモル比が、80 : 20 となるように両者を仕込んだ以外は、実施例 1 と同様の条件下で反応および操作を行ない、架橋共重合体のナトリウム塩を得た。次いで、実施例 2 と同様の操作を行ない、架橋共重合体のカルシウム塩を得た。得られた架橋共重合体（カルシウム塩）、即ち、農園芸用保水材の吸液倍率は 18.8 g/g であった。農園芸用保水材の製造時の

主な条件と共に、吸液倍率を表1に記載した。

【0054】次に、上記農園芸用保水材の性能を実施例1と同様の条件下にて評価した。その結果、発芽率は96%であった。また、生育状況は良好であった。これら評価結果を、表3に記載した。

【0055】〔実施例6〕実施例1における、エチレンオキサイドの平均付加モル数が9モルであるメトキシポリエチレングリコールメタクリレートに代えて、エチレンオキサイドの平均付加モル数が50モルであるプトキシポリエチレングリコールメタクリレートを用い、かつ、メタクリル酸ナトリウム水溶液中のメタクリル酸成分と、プトキシポリエチレングリコールメタクリレートとのモル比が、80:20となるように両者を仕込んだ以外は、実施例1と同様の条件下で反応および操作を行ない、架橋共重合体のナトリウム塩を得た。次いで、実施例2と同様の操作を行ない、架橋共重合体のカルシウム塩を得た。得られた架橋共重合体（カルシウム塩）、即ち、農園芸用保水材の吸液倍率は14.1 g/gであった。農園芸用保水材の製造時の主な条件と共に、吸液倍率を表1に記載した。

【0056】次に、上記農園芸用保水材の性能を実施例1と同様の条件下にて評価した。その結果、発芽率は96%であった。また、生育状況は良好であった。これら評価結果を、表3に記載した。

【0057】〔実施例7〕実施例1と同様の反応器に、アニオン性単量体のアルカリ土類金属塩である35重量%メタクリル酸マグネシウム水溶液 203部、メトキシポリエチレングリコールメタクリレート 169部、イオン交換水23.2部、および、ポリエチレングリコールジアクリレート0.41部を仕込んで反応液とした。上記のメトキシポリエチレングリコールメタクリレートにおけるエチレンオキサイドの平均付加モル数は9モルである。また、ポリエチレングリコールジアクリレートにおけるエチレンオキサイドの平均付加モル数は8モルである。

【0058】つまり、メタクリル酸マグネシウム水溶液中のメタクリル酸成分と、メトキシポリエチレングリコールメタクリレートとのモル比が、67:33となるようにすると共に、反応液における単量体成分の濃度が、60重量%となるように両者を仕込んだ。また、ポリエチレングリコールジアクリレートを、上記の単量体成分に対する割合が0.12モル%となるように仕込んだ。尚、マグネシウムは二価金属であるので、上記メタクリル酸マグネシウムには、1モル当たり、メタクリル酸成分が2モル含まれていることになる。

【0059】次に、上記の反応液に窒素ガスを吹き込んで溶存酸素を追い出すと共に、反応系を窒素ガス置換した。続いて、水浴を用いて反応液の温度を40℃に昇温した後、10重量% 2,2'-アゾビス（2-アミジノプロパン）塩酸塩水溶液4.44部を添加した。そして、該反応液を攪拌・混合した後、攪拌を停止した。すると、直ちに重合

反応が開始された。2,2'-アゾビス（2-アミジノプロパン）塩酸塩は、単量体成分に対する割合が0.15モル%となるように添加した。

【0060】上記の重合反応においては、反応を開始してから38分後に反応液の温度が93℃になり、ピークに達した。この間、水浴の温度は、反応液の温度とほぼ等しくなるように適宜昇温させた。反応液の温度がピークに達した後、水浴の温度を80℃に維持し、該反応液を30分間熟成した。反応終了後、得られた含水ゲル状重合体を取り出し、微粒子状に解砕した。

【0061】解砕した含水ゲル状重合体を、熱風循環式乾燥機を用いて窒素気流下、150℃で1時間乾燥した。次いで、該乾燥物1部にイオン交換水3000部を混合し、1時間攪拌した後、濾過した。得られた濾液（含水ゲル）を減圧乾燥した後、乾燥物を卓上型粉碎機を用いて粉碎した。これにより、粉末状の架橋共重合体のマグネシウム塩を得た。得られた架橋共重合体（マグネシウム塩）、即ち、農園芸用保水材の吸液倍率は18.9 g/gであった。農園芸用保水材の製造時の主な条件と共に、吸液倍率を表1に記載した。

【0062】次に、上記農園芸用保水材の性能を実施例1と同様の条件下にて評価した。その結果、発芽率は86%であった。また、生育状況は良好であった。これら評価結果を、表3に記載した。

【0063】〔実施例8〕実施例1と同様の反応器に、アニオン性単量体のアルカリ土類金属塩である10重量%メタクリル酸カルシウム水溶液 313部、メトキシポリエチレングリコールメタクリレート68.7部、イオン交換水16.9部、および、ポリエチレングリコールジアクリレート0.17部を仕込んで反応液とした。上記のメトキシポリエチレングリコールメタクリレートにおけるエチレンオキサイドの平均付加モル数は9モルである。また、ポリエチレングリコールジアクリレートにおけるエチレンオキサイドの平均付加モル数は8モルである。

【0064】つまり、メタクリル酸カルシウム水溶液中のメタクリル酸成分と、メトキシポリエチレングリコールメタクリレートとのモル比が、67:33となるようにすると共に、反応液における単量体成分の濃度が、25重量%となるように両者を仕込んだ。また、ポリエチレングリコールジアクリレートを、上記の単量体成分に対する割合が0.12モル%となるように仕込んだ。尚、カルシウムは二価金属であるので、上記メタクリル酸カルシウムには、1モル当たり、メタクリル酸成分が2モル含まれていることになる。

【0065】次に、上記の反応液に窒素ガスを吹き込んで溶存酸素を追い出すと共に、反応系を窒素ガス置換した。続いて、水浴を用いて反応液の温度を50℃に昇温した後、10重量% 2,2'-アゾビス（2-アミジノプロパン）塩酸塩水溶液1.21部を添加した。そして、該反応液を攪拌・混合した後、攪拌を停止した。すると、直ちに重合



反応が開始された。2,2'-アゾビス(2-アミジノプロパン)塩酸塩は、単量体成分に対する割合が0.15モル%となるように添加した。

【0066】上記の重合反応においては、反応を開始してから60分後に反応液の温度が58℃になり、ピークに達した。この間、水浴の温度は、反応液の温度とほぼ等しくなるように適宜昇温させた。反応液の温度がピークに達した後、水浴の温度を80℃に昇温し、該反応液を60分間熟成した。反応終了後、得られた含水ゲル状重合体を取り出し、微粒子状に解砕した。

【0067】解砕した含水ゲル状重合体を、熱風循環式乾燥機を用いて窒素気流下、150℃で1時間乾燥した。次いで、該乾燥物1部にイオン交換水3000部を混合し、1時間攪拌した後、濾過した。得られた濾液(含水ゲル)を減圧乾燥した後、乾燥物を卓上型粉碎機を用いて粉碎した。これにより、粉末状の架橋共重合体のカルシウム塩を得た。得られた架橋共重合体(カルシウム塩)、即ち、農園芸用保水材の吸液倍率は63.0 g/gであった。農園芸用保水材の製造時の主な条件と共に、吸液倍率を表1に記載した。

【0068】次に、上記農園芸用保水材の性能を実施例1と同様の条件下にて評価した。その結果、発芽率は98%であった。また、生育状況は良好であった。これら評価結果を、表3に記載した。

【0069】〔比較例1〕まず、実施例1と同様の反応および操作を行ない、架橋共重合体のナトリウム塩を得た。次いで、該架橋共重合体1部にイオン交換水3000部を混合し、1時間攪拌した後、濾過した。得られた濾液(含水ゲル)を減圧乾燥した後、乾燥物を卓上型粉碎機を用いて粉碎した。これにより、粉末状の架橋共重合体のナトリウム塩、即ち、比較用の農園芸用保水材を得た。得られた比較用の農園芸用保水材の吸液倍率は22.6 g/gであった。比較用の農園芸用保水材の製造時の主な条件と共に、吸液倍率を表2に記載した。

【0070】次に、上記比較用の農園芸用保水材の性能を実施例1と同様の条件下にて評価した。その結果、発芽率は66%であった。また、生育状況は不良であり、二十日大根は枯死した。これら評価結果を、表3に記載した。

【0071】〔比較例2〕市販のアクリル酸ナトリウム-アクリルアミド架橋重合体1部にイオン交換水3000部を混合し、1時間攪拌した後、濾過した。上記の架橋重合体におけるアクリル酸成分と、アクリルアミドとのモル比は、30:70であった。

【0072】得られた濾液(含水ゲル)を減圧乾燥した後、乾燥物を卓上型粉碎機を用いて粉碎した。これにより、粉末状の架橋共重合体(架橋重合体)のナトリウム塩、即ち、比較用の農園芸用保水材を得た。得られた比較用の農園芸用保水材の吸液倍率は25.3 g/gであった。吸液倍率等を表2に記載した。

【0073】次に、上記比較用の農園芸用保水材の性能を実施例1と同様の条件下にて評価した。その結果、発芽率は58%であった。また、生育状況は不良であり、二十日大根は枯死した。これら評価結果を、表3に記載した。

【0074】〔比較例3〕市販のアクリル酸ナトリウム架橋重合体1部にイオン交換水3000部を混合し、1時間攪拌した後、濾過した。得られた濾液(含水ゲル)を減圧乾燥した後、乾燥物を卓上型粉碎機を用いて粉碎した。これにより、粉末状の重合体のナトリウム塩、即ち、比較用の農園芸用保水材を得た。得られた比較用の農園芸用保水材の吸液倍率は3.8 g/gであった。吸液倍率等を表2に記載した。

【0075】次に、上記比較用の農園芸用保水材の性能を実施例1と同様の条件下にて評価した。その結果、発芽率は54%であった。また、生育状況は不良であり、二十日大根は枯死した。これら評価結果を、表3に記載した。

【0076】〔比較例4〕実施例1と同様の反応器に、40重量%アクリル酸マグネシウム水溶液 100.2部、40重量%アクリルアミド水溶液 199.8部、イオン交換水73.8部、および、架橋剤としての1.5重量%N,N-メチレンビスアクリルアミド水溶液16.5部を仕込んで反応液とした。つまり、アクリル酸マグネシウム水溶液中のアクリル酸成分と、アクリルアミドとのモル比が、30:70となるようにすると共に、反応液における上記アクリル酸成分とアクリルアミドとの合計の濃度、即ち、単量体成分の濃度が、30重量%となるように両者を仕込んだ。また、N,N-メチレンビスアクリルアミドを、上記の単量体成分に対する割合が0.1モル%となるように仕込んだ。

【0077】次に、上記の反応液に窒素ガスを吹き込んで溶存酸素を追いつくと共に、反応系を窒素ガス置換した。続いて、水浴を用いて反応液の温度を20℃に昇温した後、重合開始剤としての10重量%過硫酸ナトリウム水溶液4.88部および1重量%L-アスコルビン酸ナトリウム水溶液4.81部を添加した。そして、該反応液を攪拌・混合した後、攪拌を停止した。すると、直ちに重合反応が開始された。過硫酸ナトリウムは、単量体成分に対する割合が0.15モル%となるように添加した。また、L-アスコルビン酸ナトリウムは、単量体成分に対する割合が0.02モル%となるように添加した。

【0078】上記の重合反応においては、反応を開始してから3分後に反応液の温度が108℃になり、ピークに達した。この間、水浴の温度は、90℃になるまで、反応液の温度とほぼ等しくなるように適宜昇温させた。反応液の温度がピークに達した後、水浴の温度を80℃に維持し、該反応液を30分間熟成した。反応終了後、得られた含水ゲル状重合体を取り出し、微粒子状に解砕した。

【0079】解砕した含水ゲル状重合体を、熱風循環式乾燥機を用いて窒素気流下、150℃で1時間乾燥した。

次いで、該乾燥物1部にイオン交換水3000部を混合し、1時間攪拌した後、濾過した。得られた濾液(含水ゲル)を減圧乾燥した後、乾燥物を卓上型粉砕機を用いて粉砕した。これにより、粉末状の架橋共重合体のマグネシウム塩、即ち、比較用の農園芸用保水材を得た。得られた比較用の農園芸用保水材の吸液倍率は19.2 g/gであった。比較用の農園芸用保水材の製造時の主な条件と共に、吸液倍率を表2に記載した。

【0080】次に、上記比較用の農園芸用保水材の性能を実施例1と同様の条件下にて評価した。その結果、発芽率は82%であった。また、生育状況は不良であり、二十日大根は枯死した。これら評価結果を、表3に記載した。

【0081】

【表1】

|             |   | アニオン性単量体         | ノニオン性単量体                                    | 単量体成分の<br>モル比 | 塩の種類    | 吸液倍率<br>(g/g) |
|-------------|---|------------------|---|---------------|---------|---------------|
| 実<br>施<br>例 | 1 | メタクリル酸<br>ナトリウム  | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数9モル)  | 67/33         | マグネシウム塩 | 15.9          |
|             | 2 | 同 上              | 同 上   | 67/33         | カルシウム塩  | 21.0          |
|             | 3 | 同 上              | 同 上   | 5/95          | カルシウム塩  | 17.2          |
|             | 4 | 同 上              | 同 上   | 95/5          | カルシウム塩  | 5.4           |
|             | 5 | アクリル酸<br>ナトリウム   | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数23モル) | 80/20         | カルシウム塩  | 18.8          |
|             | 6 | メタクリル酸<br>ナトリウム  | ブトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数50モル) | 80/20         | カルシウム塩  | 14.1          |
|             | 7 | メタクリル酸<br>マグネシウム | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数9モル)  | 67/33         | マグネシウム塩 | 18.9          |
|             | 8 | メタクリル酸<br>カルシウム  | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数9モル)  | 67/33         | カルシウム塩  | 63.0          |

【0082】

【表2】

|             |   | アニオン性単量体        | ノニオン性単量体                                   | 単量体成分の<br>モル比 | 塩の種類    | 吸液倍率<br>(g/g) |
|-------------|---|-----------------|--|---------------|---------|---------------|
| 比<br>較<br>例 | 1 | メタクリル酸<br>ナトリウム | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数9モル) | 67/33         | ナトリウム塩  | 22.6          |
|             | 2 | アクリル酸<br>ナトリウム  | アクリルアミド                                    | 30/70         | ナトリウム塩  | 25.3          |
|             | 3 | アクリル酸<br>ナトリウム  | ——   | ——            | ナトリウム塩  | 3.8           |
|             | 4 | アクリル酸<br>マグネシウム | アクリルアミド                                    | 30/70         | マグネシウム塩 | 19.2          |

【0083】

【表3】

|     |   | 発芽率<br>(%) | 生育状況   |
|-----|---|------------|--------|
| 実施例 | 1 | 88         | 良好     |
|     | 2 | 100        | 良好     |
|     | 3 | 92         | 良好     |
|     | 4 | 94         | 良好     |
|     | 5 | 96         | 良好     |
|     | 6 | 96         | 良好     |
|     | 7 | 86         | 良好     |
|     | 8 | 98         | 良好     |
| 比較例 | 1 | 66         | 不良(枯死) |
|     | 2 | 58         | 不良(枯死) |
|     | 3 | 54         | 不良(枯死) |
|     | 4 | 82         | 不良(枯死) |

【0084】表1および表3から明らかなように、本実施例にかかる農園芸用保水材は、吸液倍率が高く、従って保水性に優れ、かつ、植物の根に対する親和性に優れていることがわかる。これに対し、表2および表3から明らかなように、比較例1、2、4にかかる比較用の農園芸用保水材は、吸液倍率が高く、保水性に優れるものの、植物の根に対する親和性に劣り、発芽や発根、生長等を阻害することがわかる。また、比較例3にかかる比較用の農園芸用保水材は、吸液倍率が低く、保水性に劣

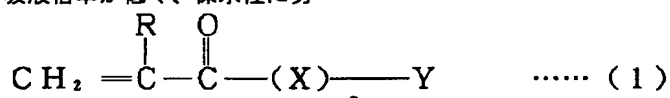
ると共に、植物の根に対する親和性にも劣ることがわかる。

【0085】

【発明の効果】本発明の請求項1記載の農園芸用保水材は、以上のように、アニオン性単量体、および一般式(1)

【0086】

【化3】



【0087】(式中、Rは水素原子またはメチル基を表し、Xは全オキシアルキレン基に対するオキシエチレン基のモル分率が50モル%以上である炭素数2～4のオキシアルキレン基を表し、Yは炭素数1～5のアルコキシ基、フェノキシ基、または置換基として炭素数1～9のアルキル基を1～3個有するオキシアルキルフェニル基を表し、nは平均で3～100の整数を表す)で表されるノニオン性単量体を含む単量体成分から導かれる架橋共

重合体のアルカリ土類金属塩を含む構成である。また、本発明の請求項2記載の農園芸用保水材は、以上のように、アルカリ土類金属がカルシウムである構成である。

【0088】これにより、吸液倍率が高く、従って保水性に優れ、かつ、植物の根に対する親和性に優れた農園芸用保水材を提供することができるという効果を奏する。

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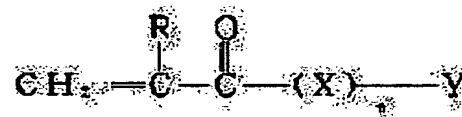
(72)Inventor : SHIOJI NAOTAKE  
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## (54) WATER-RETENTION MATERIAL FOR AGRICULTURE AND HORTICULTURE

## (57)Abstract:

PROBLEM TO BE SOLVED: To obtain the subject water-retention material having high solution-absorption ratio, excellent water retentivity and high affinity to a root of a plant, and useful for prevention of making soil to be desert-like by cross-linking and copolymerizing an anionic monomer with a monomer component containing a specific nonionic monomer.

SOLUTION: The objective water-retention material having high solution-absorption ratio, excellent water retentivity and high affinity to a root of a plant is obtained by copolymerizing an anionic monomer (e.g.; methacrylic acid) with a monomer component containing a nonionic monomer of the formula (R is H or methyl; X is a 2-4C oxyalkylene group having  $\geq 50$ mol% mol fraction of oxyethylene group to whole oxyalkylene group; Y is a 1-5C alkoxy, phenoxy or an oxyalkylphenyl group having 1-3 pieces of a 1-9C alkyl group as a substituting group; (n) is an integer of 3-100 as an average) (e.g.; methoxypolyethylene glycol monoacrylate), generating an alkaline earth metallic salt by adding an alkaline earth metallic compound (e.g.; calcium chloride), then cross-linking.



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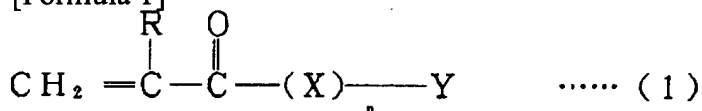
 CLAIMS
 

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[Claim(s)]

[Claim 1] An anionic monomer and a general formula (1)

[Formula 1]



(R expresses a hydrogen atom or a methyl group among a formula, and X expresses the oxy-alkylene group of the carbon numbers 2-4 whose mole fractions of the oxyethylene radical to all oxy-alkylene groups are more than 50 mol %.) Y expresses the alkoxy group of carbon numbers 1-5, a phenoxy group, or the oxy-alkylphenyl radical that has 1-3 alkyl groups of carbon numbers 1-9 as a substituent. n -- an average -- the integer of 3-100 -- expressing -- the water retention material for plantation arts characterized by including the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component containing the nonionic monomer expressed.

[Claim 2] Water retention material for plantation arts according to claim 1 characterized by alkaline earth metal being calcium.

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 [Translation done.]

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the water retention material for plantation arts offered suitable for environmental preservation, such as tree planting of a desert and prevention of desertification of soil, or a kitchen garden.

[0002]

[Description of the Prior Art] Conventionally, the water retention material which consists of anion mold polymers, such as the Nonion mold polymers, such as an acrylamide system polymer, or an acrylic-acid system polymer, is known. However, although the Nonion mold polymer has high compatibility to a vegetable root, it has the fault that a liquid absorption scale factor is low and inferior to water retention. Moreover, although an anion mold polymer has a high liquid absorption scale factor and being excelled in water retention, since the bad influence of it being inferior to the compatibility over a vegetable root, and checking a sprout, rooting, growth, etc. is done, it has the fault that vegetation tends to wither. For this reason, the above-mentioned water retention material is unsuitable although offered as water retention material for plantation arts.

[0003] Then, the water retention material for plantation arts which consists of a bridge formation copolymer led from the monomer component containing an anionic monomer and a nonionic monomer is proposed (JP,3-8736,B, JP,3-149288,A).

[0004]

[Problem(s) to be Solved by the Invention] However, also in the above-mentioned conventional water retention material for plantation arts, it is hard to say that the balance of water retention and the compatibility over a vegetable root is inadequate, and it has the engine performance with which are satisfied of both. Therefore, it is anxious for the water retention material for plantation arts which was excellent in water retention and was excellent in the compatibility over a vegetable root.

[0005] It is in offering the water retention material for plantation arts which this invention was made in view of the above-mentioned conventional trouble, and excelled [ purpose / the ] in water retention, and was excellent in the compatibility over a vegetable root.

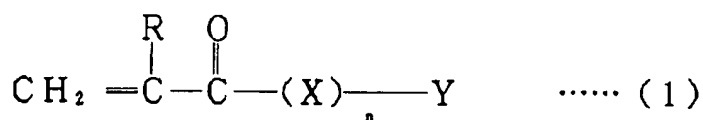
[0006]

[Means for Solving the Problem] As a result of inquiring wholeheartedly that the above-mentioned purpose should be attained, the water retention material for plantation arts containing the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component containing an anionic monomer and the nonionic monomer of specific structure has a high liquid absorption scale factor, therefore an invention-in-this-application person etc. excels [ material ] in water retention, moreover finds out having high compatibility to a vegetable root, and came to complete this invention.

[0007] That is, the water retention material for plantation arts of invention according to claim 1 is an anionic monomer and a general formula (1), in order to solve the above-mentioned technical problem.

[0008]

[Formula 2]



[0009] (R expresses a hydrogen atom or a methyl group among a formula, and X expresses the oxy-alkylene group of the carbon numbers 2-4 whose mole fractions of the oxyethylene radical to all oxy-alkylene groups are more than 50 mol %.) Y expresses the alkoxy group of carbon numbers 1-5, a phenoxy group, or the oxy-alkylphenyl radical that has 1-3 alkyl groups of carbon numbers 1-9 as a substituent. n -- an average -- the integer of 3-100 -- expressing -- it is characterized by including the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component containing the nonionic monomer expressed.

[0010] The water retention material for plantation arts of invention according to claim 2 is characterized by alkaline earth metal being calcium in the water retention material for plantation arts according to claim 1, in order to solve the above-mentioned technical problem.

[0011] According to the above-mentioned configuration, the water retention material for plantation arts contains the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component containing an anionic monomer and the nonionic monomer of specific structure. The water retention material for plantation arts which whose liquid absorption scale factor was high, was excellent in water retention by this, and was excellent in the compatibility over a vegetable root can be offered.

[0012] This invention is explained in detail below. The water retention material for plantation arts concerning this invention contains the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component containing an anionic monomer and the nonionic monomer of specific structure. The above-mentioned alkaline earth metal has magnesium and more desirable calcium, and especially its calcium is desirable. In addition, the above-mentioned monomer component may contain other monomers other than an anionic monomer and a nonionic monomer within limits which do not spoil the engine performance as water retention material for plantation arts.

[0013] The above-mentioned anionic monomer is not especially limited like the after-mentioned that what is necessary is just the monomer which can form alkaline earth metal and a salt. As an anionic monomer, specifically For example, an acrylic acid (meta), Partial saturation monocarboxylic acid system monomers and these alkali-metal salts, such as a crotonic acid; A maleic acid, Partial saturation dicarboxylic acid system monomers and these alkali-metal salts, such as a fumaric acid, an itaconic acid, and a citraconic acid; A vinyl sulfonic acid, An allyl compound sulfonic acid, a metallyl sulfonic acid, a styrene sulfonic acid, 2-acrylamide - isobutane sulfonic acid, Sulfoethyl (meta) acrylate, sulfopropyl (meta) acrylate, Partial saturation sulfonic-acid system monomers and these alkali-metal salts, such as 2-hydroxy sulfopropyl (meta) acrylate; (meta) Acrylamide methane phosphonic acid, 2-(meta) acrylamide Partial saturation phosphonic acid system monomers, these alkaline-earth-metal salts, etc., such as - isobutane phosphonic acid, are mentioned. These anionic monomer may be used independently, and may mix two or more kinds suitably, and may be used. Partial saturation monocarboxylic acid system monomers and these alkaline-earth-metal salts are more desirable among the monomers of the above-mentioned instantiation, acrylic acids (meta) and these alkaline-earth-metal salts are still more desirable, and a methacrylic acid and especially its alkaline-earth-metal salt are desirable. In addition, an anionic monomer has the function which gives moderate gel strength to this water retention material for plantation arts while raising the liquid absorption scale factor of the water retention material for plantation arts obtained. And by having moderate gel strength, the water retention material for plantation arts is swollen in soil, forms an opening, and gives permeability to this soil.

[0014] As a nonionic monomer expressed with said general formula (1) Specifically For example, methoxy polyethylene-glycol monochrome (meta) acrylate, Ethoxy polyethylene-glycol monochrome (meta) acrylate, butoxy polyethylene-glycol monochrome (meta) acrylate, Methoxy polyethylene-glycol polypropylene-glycol monochrome (meta) acrylate, Methoxy polyethylene-glycol polybutylene glycol monochrome (meta) acrylate, Ethoxy polyethylene-glycol polypropylene-glycol monochrome (meta) acrylate, Ethoxy polyethylene-glycol polybutylene glycol monochrome (meta) acrylate, Acrylic ester



(meta) system monomers, such as phenoxy polyethylene-glycol monochrome (meta) acrylate and benzyloxy polyethylene-glycol monochrome (meta) acrylate, are mentioned. These nonionic monomer may be used independently, and may mix two or more kinds suitably, and may be used. Methoxy polyethylene-glycol methacrylate is more desirable among the monomers of the above-mentioned instantiation. Moreover, when using methoxy polyethylene-glycol methacrylate as a nonionic monomer, the number of average addition mols of ethyleneoxide has desirable within the limits of five mols - 50 mols. That is, when Y is a methoxy group, within the limits of n of 5-50 is desirable [ X in a general formula (1) is an oxyethylene radical, and R is a methyl group, and ]. In addition, the polyoxyalkylene chain in a nonionic monomer has the function which raises the compatibility over the root of the vegetation of the water retention material for plantation arts obtained, the salt atmosphere of this water retention material for plantation arts, etc.

[0015] Although especially the rate of the anionic monomer in the above-mentioned the ratio of an anionic monomer and a nonionic monomer, i.e., bridge formation copolymer component, is not limited, 5 % of the weight - 95% of the weight of its within the limits is more desirable, and 10 % of the weight - 70% of the weight of its within the limits is still more desirable. When there are few rates of an anionic monomer than 5 % of the weight, the liquid absorption scale factor of the alkaline-earth-metal salt of a bridge formation copolymer becomes low. The gel strength of the water retention material for plantation arts obtained falls, and it becomes impossible moreover, to give permeability to soil. When there are more rates of an anionic monomer than 95 % of the weight, there is an inclination for the leached moiety (meltable component) in the bridge formation copolymer obtained to increase. Moreover, the compatibility over the root of the vegetation of the water retention material for plantation arts obtained and the salt atmosphere of this water retention material for plantation arts fall. Therefore, there is a possibility that the water retention material for plantation arts equipped with the physical properties for which it asks may not be obtained.

[0016] The approach of manufacturing the alkaline-earth-metal salt of a bridge formation copolymer After making for example, not the thing limited especially but \*\* anionic monomer, and chlorides, such as a calcium chloride and a magnesium chloride, react and forming the alkaline-earth-metal salt of an anionic monomer, The approach and \*\* anionic monomer to which copolymerization of the nonionic monomer is added and carried out, The approach and \*\* anionic monomer to which copolymerization of the nonionic monomer is added and carried out after making hydroxides, such as a calcium hydroxide and a magnesium hydroxide, react and forming the alkaline-earth-metal salt of an anionic monomer, After making carbonates, such as a calcium carbonate and a magnesium carbonate, react and forming the alkaline-earth-metal salt of an anionic monomer, After carrying out copolymerization of the approach and \*\* anionic monomer to which copolymerization of the nonionic monomer is added and carried out, and the nonionic monomer, After carrying out copolymerization of the approach and \*\* anionic monomer which add the above-mentioned chloride and form an alkaline-earth-metal salt, and the nonionic monomer, After carrying out copolymerization of the approach and \*\* anionic monomer which add the above-mentioned hydroxide and form an alkaline-earth-metal salt, and the nonionic monomer, various approaches, such as the approach of adding the above-mentioned carbonate and forming an alkaline-earth-metal salt, are employable. Moreover, after mixing an anionic monomer, a nonionic monomer, and a chloride, an above-mentioned hydroxide or an above-mentioned carbonate, copolymerization can be carried out and the alkaline-earth-metal salt of a bridge formation copolymer can also be manufactured. The approach of the approach of \*\* - \*\* is more desirable among these approaches, the approach of the approach of \*\* - \*\* is still more desirable, and especially the approach of \*\* is desirable. Moreover, when adopting the approach of the above-mentioned \*\*, especially a chloride has a desirable calcium chloride.

[0017] Furthermore, once forming the alkali-metal salt of a bridge formation copolymer, the alkaline-earth-metal salt of a bridge formation copolymer can also be manufactured by permuting this alkali-metal salt by the alkaline-earth-metal salt. In this case, molecular weight of a bridge formation copolymer can be further enlarged by carrying out copolymerization of the alkali-metal salt of an anionic monomer, and the nonionic monomer, and forming the alkali-metal salt of a bridge formation

copolymer. In addition, sodium of alkali metal is more desirable.

[0018] Although the alkaline-earth-metal salt of the bridge formation copolymer in the invention in this application is not clear about the reason whose leached moiety decreases compared with alkali-metal salts, such as sodium salt and potassium salt, it guesses as follows. That is, it is guessed that it is for the solubility of a fusibility polymer to fall as a result of constructing a bridge over this fusibility polymer two-dimensional or in three dimensions with alkaline earth metal although a leached moiety uses a fusibility polymer as a principal component.

[0019] Well-known various approaches, for example, a solution polymerization method, a suspension-polymerization method, an opposition suspension-polymerization method or a casting polymerization method, a thin film polymerization method, a spray polymerization method, etc. can be conventionally used for a polymerization method. In addition, although especially the stirring approach at the time of performing a polymerization reaction is not limited, it is more desirable to stir subdividing the gel bridge formation copolymer (it mentioning later) to generate according to this double arm mold kneader's shearing force using a double arm mold kneader as stirring equipment.

[0020] Specifically as a dispersant suitable when adopting an opposition suspension-polymerization method, carboxyl group content polymers, such as cellulose ester, such as a sorbitan fatty acid ester, sucrose fatty acid ester, a glycerine fatty acid ester, polyglyceryl fatty acid ester, ethyl cellulose, and cellulose acetate, cellulose ether, and an alpha olefin-maleic-anhydride copolymer, etc. are mentioned. These dispersants may be used independently, and may mix two or more kinds suitably, and may be used. In addition, especially the hydrophobic organic solvent offered when adopting an opposition suspension-polymerization method is not limited.

[0021] Although it is not limited, since low-temperature one becomes large, its molecular weight of a bridge formation copolymer is comparatively desirable, and since a polymerization reaction completes especially reaction temperature, within the limits of 20 degrees C - 100 degree C is still more desirable [ reaction temperature ]. In addition, what is necessary is just to set up reaction time suitably according to the class (property) of reaction temperature, a monomer component, a polymerization initiator, a solvent, etc., etc., combination, the amount used, etc. so that the above-mentioned polymerization reaction may be completed.

[0022] A polymerization initiator can be used in case copolymerization of the monomer component is carried out. Specifically as this polymerization initiator, they are peroxides, such as a hydrogen peroxide, benzoyl peroxide, and cumene hydroperoxide.; Azo compounds, such as a 2 and 2'-azobisisobutyronitril, 2, 2'-azobis (2-amidinopropane) hydrochloride; radical generating agents (radical polymerization initiator), such as persulfate, such as ammonium persulfate, sodium persulfate, and potassium persulfate, etc. are mentioned. These polymerization initiators may be used independently, and may mix two or more kinds suitably, and may be used. Furthermore, the redox system initiator which comes to combine these radical generating agent and reducing agents, such as a sodium hydrogensulfite, and L-ascorbic acid (salt), ferrous salt, may be used. In addition, instead of using a polymerization initiator, a radiation, an electron ray, ultraviolet rays, etc. may be irradiated, and a polymerization initiator and the exposure of these radiations, an electron ray, ultraviolet rays, etc., etc. may be used together.

[0023] Although especially the amount of the polymerization initiator used is not limited, 0.001 % of the weight - 10% of the weight of its within the limits is more desirable to a monomer component, and 0.01 % of the weight - 1% of the weight of its within the limits is still more desirable. Moreover, although especially the amount of the reducing agent used in the case of using a redox system initiator is not limited, its within the limits of 0.01-5 is more desirable to a radical generating agent at a weight ratio, and its within the limits of 0.05-2 is still more desirable.

[0024] Moreover, in case copolymerization of the monomer component is carried out, a cross linking agent may be used if needed. As this cross linking agent, specifically For example, a divinylbenzene, ethylene GURIKORUJI (meta) acrylate, Diethylene GURIKORUJI (meta) acrylate, TORIECHIRENGURIKORUJI (meta) acrylate, Propylene GURIKORUJI (meta) acrylate, polyethylene GURIKORUJI (meta) acrylate, TORIMECHI roll pro pantry (meta) acrylate, pen TAERISURITORUJI

(meta) acrylate, Pen TAERISURITORUTORI (meta) acrylate, N, and N-methylenebis (meta) acrylamide, An isocyanuric acid triaryl, trimethylol propane diaryl ether, etc., The compound which has two or more ethylene system partial saturation radicals in 1 molecule; Ethylene glycol, A diethylene glycol, triethylene glycol, a polyethylene glycol, A glycerol, polyglycerin, propylene glycol, a polypropylene glycol, Polyvinyl alcohol, pentaerythritol, diethanolamine, Triethanolamine, sorbitol, sorbitan, a glucose, mannite, Polyhydric alcohol, such as Manni Tan, cane sugar, and grape sugar; Ethylene glycol diglycidyl ether, Polyethylene glycol diglycidyl ether, glycerol diglycidyl ether, Propylene glycol diglycidyl ether, polypropylene glycol diglycidyl ether, Neopentyl glycol diglycidyl ether, 1, 6-hexanediol diglycidyl ether, The Pori epoxy compounds, such as trimethylol propane diglycidyl ether, trimethylolpropane triglycidyl ether, and glycerol triglycidyl ether, etc. are mentioned. These cross linking agents may be used independently, and they may be mixed suitably and two or more kinds may be used for them.

[0025] Since the crosslinking density of a bridge formation copolymer is controllable by using a cross linking agent, the water retention ability (for example, liquid absorption scale factor etc.) of the water retention material for plantation arts can be adjusted. What is necessary is not to limit especially the amount of the cross linking agent used, and just to set it up suitably by the class of a monomer component or cross linking agent, crosslinking density (that is, water retention ability), gel strength which are used for example, for which it asks, etc. specifically, about 0.0005 to 0.02 within the limits has [ the amount of the cross linking agent used ] a more desirable mole ratio to a monomer component - within the limits of 0.001-0.01 is still more desirable. In addition, when using polyhydric alcohol as a cross linking agent, they are after a polymerization reaction and a bridge formation copolymer. It is desirable to heat-treat at 150 degrees C - 250 degree C. Moreover, when using the Pori epoxy compound as a cross linking agent, it is desirable after a polymerization reaction to heat-treat a bridge formation copolymer at 50 degrees C - 250 degree C.

[0026] Furthermore, in case copolymerization of the monomer component is carried out, a solvent may be used if needed. Specifically as this solvent, aquosity solvents, such as a water; cyclohexane, a toluene; methanol, ethanol, an acetone, dimethylformamide, and dimethyl sulfoxide, etc. are mentioned. These solvents may be used independently, and may mix two or more kinds suitably, and may be used. Since the bridge formation copolymer with still higher compatibility [ as opposed to the root of safety or vegetation in the mixture of water and water, and an aquosity solvent ] etc. among the solvents of the above-mentioned instantiation, i.e., the water retention material for plantation arts, can be manufactured cheaply, it is more desirable. In addition, although especially the concentration of the monomer component in the case of using a solvent is not limited, 20 % of the weight - 80% of the weight of its within the limits is more desirable, and 30 % of the weight - 60% of the weight of its within the limits is still more desirable. While a polymerization reaction is easily controllable by making concentration of the monomer component in the solution containing this monomer component, a polymerization initiator, a cross linking agent, etc. into within the limits of the above, the yield of a bridge formation copolymer can be raised and this bridge formation copolymer can be obtained economically.

[0027] After a polymerization reaction, since it is usually obtained by gel, the alkaline-earth-metal salt of a bridge formation copolymer dries the alkaline-earth-metal salt of this gel bridge formation copolymer, after performing predetermined actuation of washing, a crack, etc. remaining as it is or if needed. Although especially drying temperature is not limited, within the limits of 50 degrees C - 180 degree C being suitable and its within the limits which is 100 degree C to 170 degree C are the optimal. Moreover, after a dry matter operates grinding etc. and carries out grain refining, it performs classification actuation of sieving etc. if needed. It is suitable that the liquid absorption scale factor (it mentions later) to the saturated water solution of slaked lime is within the limits of 10 g/g - 50 g/g preferably within the limits of 5 g/g - 70 g/g as a liquid absorption scale factor of the alkaline-earth-metal salt of a bridge formation copolymer. When a liquid absorption scale factor is under 5 g/g, there is a possibility that water retention may become inadequate. Moreover, when a liquid absorption scale factor exceeds 70 g/g, it tends to be inferior to endurance. In addition, especially a configuration, mean particle diameter, etc. of the water retention material for plantation arts are not limited.

[0028] Furthermore, in order to reduce a leached moiety and to raise further the safety of this water retention material for plantation arts etc. by decreasing a bridge formation copolymer, i.e., the unreacted monomer component which remains to the water retention material for plantation arts, it is desirable to use a reducing agent and to process the alkaline-earth-metal salt of a gel bridge formation copolymer or its dry matter. Specifically as the above-mentioned reducing agent, a sodium sulfite, potassium sulfite, ammonium sulfite, a sodium hydrogensulfite, a potassium hydrogensulfite, hydrogen sulfite ammonium, a sodium thiosulfate, potassium thiosulfate, ammonium thiosulfate, L-ascorbic acid, ammonia, monoethanolamine, a glucose, etc. are mentioned. These reducing agents may be used independently, and may mix two or more kinds suitably, and may be used. A sodium sulfite, a sodium hydrogensulfite, and a sodium thiosulfate are more desirable among the reducing agents of the above-mentioned instantiation. although especially the amount of the reducing agent used is not limited, specifically, about 0.0001 to 0.02 within the limits has a more desirable mole ratio to the used monomer component - within the limits of 0.001-0.01 is still more desirable.

[0029] As for the water retention material for plantation arts concerning this invention, it is desirable to mix and use it to soil, such as soil, by 0.01 % of the weight - 20% of the weight of within the limits. When there is less amount of the water retention material for plantation arts used than 0.01 % of the weight, the effectiveness by using this water retention material for plantation arts is hard to be discovered. On the other hand, since it hardly changes to the effectiveness acquired by using this water retention material for plantation arts within the limits of the above even if it uses the water retention material for plantation arts exceeding 20 % of the weight, it is uneconomical. Moreover, since soil will hold moisture beyond the need, permeability is spoiled and there is a possibility that vegetation may cause the so-called root corrosion.

[0030] Moreover, you may mix with soil, after mixing with soil as it is and making water and liquid fertilizer absorb, in case the water retention material for plantation arts is used. Or this mixture may be mixed with soil after mixing inorganic [, such as soil, and sand, a compost, ] or organic fine particles, and the water retention material for plantation arts. In addition, the approach which especially the mixed approach of the water retention material for plantation arts to soil is not limited, and sprinkles the water retention material for plantation arts in soil at homogeneity; after sprinkling the water retention material for plantation arts in soil, the approach of cultivating soil and mixing etc. is employable.

[0031] The water retention material for plantation arts concerning this invention is a configuration containing the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component which contains an anionic monomer and the nonionic monomer expressed with said general formula (1) as mentioned above. Moreover, the water retention material for plantation arts is the configuration that alkaline earth metal is calcium, as mentioned above.

[0032] The water retention material for plantation arts which whose liquid absorption scale factor was high, was excellent in water retention by this, and was excellent in the compatibility over a vegetable root can be offered. The water retention material for plantation arts can supply the moisture to a root smoothly, and, moreover, checks neither a sprout, nor rooting, growth, etc. Moreover, the water retention material for plantation arts is excellent also in the liquid retaining ability of liquid fertilizer. Furthermore, the water retention material for plantation arts concerning this invention can maintain a high liquid absorption scale factor, when the content of a salt blended and uses it for comparatively high soil, and it shows the water retention ability moreover stabilized with time. This water retention material for plantation arts is offered suitable for environmental preservation, such as tree planting of a desert and prevention of desertification of soil, etc.

[0033]

[Example] Hereafter, although an example and the example of a comparison explain this invention to a detail further, this invention is not limited at all by these. In addition, the liquid absorption scale factor of a bridge formation copolymer was measured by the following approaches. Moreover, the "section" given in an example and the example of a comparison shows the "weight section."

[0034] (a) Liquid absorption scale-factor point \*\* of a bridge formation copolymer and the saturated water solution of slaked lime were prepared. Namely, ion exchange water It stirred for 3 hours, after

adding the slaked-lime 10 section in the 100 sections and adjusting solution temperature at 20 degrees C. Next, it is a filter paper (No.2) about this water solution, maintaining solution temperature at 20 degrees C. It used and filtered. This prepared the saturated water solution of slaked lime. In addition, this saturated water solution was saved at 20 degrees C.

[0035] Next, about 1g of bridge formation copolymers was put into the tea bag type bag at homogeneity, and it was immersed into the above-mentioned saturated water solution. Weight W1 of a tea bag type bag after pulling up a tea bag type bag after 24-hour standing at 20 degrees C and performing a fixed time amount ridge (g) It measured. Moreover, same actuation is performed without using a bridge formation copolymer, and it is the weight W0 of the tea bag type bag at that time (g). It measured. these weight W1 and W0 from -- the weight (g) of a degree type, and a liquid absorption scale-factor (g/g) = (weight W1(g)-weight W0 (g)) / bridge formation copolymer -- following -- liquid absorption scale factor (g/g) It computed. [ and ] In addition, this liquid absorption scale factor is a balanced value.

[0036] [Example 1] Content volume equipped with a thermometer, nitrogen gas entrainment tubing, and an agitator To the 600ml reactor made from plastics, it is a 43-% of the weight sodium methacrylate water solution as an anionic monomer. The 178.0 sections, methoxy polyethylene-glycol methacrylate as a nonionic monomer The 163.4 sections, the ion-exchange-water 53.9 section as a solvent, and the polyethylene-glycol diacrylate 0.25 section as a cross linking agent were taught, and it considered as reaction mixture. The number of average addition mols of the ethyleneoxide in the above-mentioned methoxy polyethylene-glycol methacrylate is nine mols. Moreover, the number of average addition mols of the ethyleneoxide in polyethylene-glycol diacrylate is eight mols.

[0037] That is, both were taught so that the concentration of the sum total of the above-mentioned methacrylic-acid component and methoxy polyethylene-glycol methacrylate in reaction mixture, i.e., the concentration of a monomer component, might become 60 % of the weight, while making it the mole ratio of the methacrylic-acid component in a sodium methacrylate water solution and methoxy polyethylene-glycol methacrylate set to 67:33. Moreover, polyethylene-glycol diacrylate was taught so that the rate to the above-mentioned monomer component might become 0.05-mol %.

[0038] Next, while blowing nitrogen gas into the above-mentioned reaction mixture and driving out dissolved oxygen, nitrogen inert gas replacement of the system of reaction was carried out. Then, 10 % of the weight as a polymerization initiator after carrying out the temperature up of the temperature of reaction mixture to 40 degrees C using a water bath 2 and 2'-azobis (2-amidinopropane) hydrochloride (Wako Pure Chem Industries make; trade name V-50) water solution The 4.3 sections were added. And stirring was stopped after stirring and mixing this reaction mixture. Then, the polymerization reaction was started immediately. The 2 and 2'-azobis (2-amidinopropane) hydrochloride was added so that the rate to a monomer component might become 0.15-mol %.

[0039] Since a reaction is started in the above-mentioned polymerization reaction The temperature of reaction mixture became 88 degrees C after 107 minutes, and the peak was reached. In the meantime, the temperature up of the temperature of a water bath was suitably carried out so that it might become almost equal to the temperature of reaction mixture. After the temperature of reaction mixture reached the peak, the temperature of a water bath was maintained at 80 degrees C, and this reaction mixture was riped for 60 minutes. The obtained water gel polymer was taken out after reaction termination, and it cracked in the shape of a particle.

[0040] After drying the cracked water gel polymer at the bottom of a nitrogen air current, and 150 degree C for 1 hour using a hot blast circulation type dryer, the dry matter was ground using the table-top-type grinder, and the sodium salt of a bridge formation copolymer was obtained. The liquid absorption scale factor of the obtained bridge formation copolymer (sodium salt) was measured by the above-mentioned approach. Consequently, the liquid absorption scale factor was 20.9 g/g. Moreover, this bridge formation copolymer had the anionic functional group of perg and 2.95 millimol (equivalent).

[0041] Next, the sodium salt of the above-mentioned bridge formation copolymer was permuted by magnesium salt (alkaline-earth-metal salt). Namely, anhydrous salt-ized magnesium After adding the water solution which comes to dissolve 0.281g (2.95 millimol) in 10g of ion exchange water to 1g of

these bridge formation copolymers, it put at 50 degrees C for 1 hour. This obtained water gel. Subsequently, it filtered, after having mixed ion exchange water so that the whole quantity might become this water gel with 1000g, and stirring for 1 hour (the 1st time).

[0042] It filtered, after having filtered (the 2nd time), having mixed ion exchange water so that the whole quantity might be further set to 1000g at this filtration residue after having mixed ion exchange water so that the whole quantity might become the obtained filtration residue (water gel) with 1000g, and stirring for 1 hour, and stirring for 1 hour (the 3rd time). Subsequently, after carrying out reduced pressure drying of the filtration residue (water gel) obtained by the 3rd filtration, the dry matter was ground using the table-top-type grinder. This obtained the magnesium salt of a powder-like bridge formation copolymer.

[0043] It is the following that the obtained bridge formation copolymer is permuted by magnesium salt from sodium salt, and it was made and checked. That is, in the filtrate obtained by the 1st time and the 2nd above-mentioned filtration, in total, magnesium ion is 1.48 millimols and sodium ion is 2.97 millimol \*\* rare \*\*\*\*\*. Moreover, sodium ion was not contained in the filtrate obtained by the 3rd above-mentioned filtration at a magnesium ion list. Therefore, it turned out that the sodium ion with which formation of a salt was presented was eluted in filtrate. Moreover, it turned out that the magnesium ion with which formation of a salt was presented is 1.47 millimols. And it turned out that the number of mols of the magnesium ion with which sodium was univalent metal, magnesium was a divalent metal, and formation of a salt was presented since the bridge formation copolymer had the anionic functional group of 2.95 millimols / g is in agreement with a theoretical value. This checked that the bridge formation copolymer was permuted by magnesium salt from sodium salt.

[0044] The obtained bridge formation copolymer (magnesium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was measured by the above-mentioned approach. Consequently, the liquid absorption scale factor was 15.9 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0045] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated. Namely, river sand (soil) In the 150 sections, the water retention material 0.15 above-mentioned sections for plantation arts and the slaked-lime 5 section were mixed, and this mixture (river sand is only called hereafter) was put [ sections ] into the predetermined seedling raising box at homogeneity. Subsequently, tap water was dropped until water flowed into the above-mentioned river sand out of the seedling raising box (affusion). Then, seeding of 50 grains of seeds (the product made from TOHOKU, Inc.; name-of-article cherry mate) of a radish was carried out to river sand. And this seedling raising box was left under predetermined conditions after seeding, applying the diffused light, without performing affusion.

[0046] Consequently, after carrying out seeding, the germinating rate (it is only hereafter described as a germinating rate) of the seed in the 3rd day was 88%. Moreover, it was good when viewing estimated the growth situation (it is only hereafter described as a growth situation) of the radish in the 10th day, after carrying out seeding. In addition, the above-mentioned germinating rate was computed based on a degree type and germinating rate (%) =(number of seeds in which seed which budded carried out several/seeding) x100. These evaluation result was indicated to Table 3.

[0047] [Example 2] The same reaction and actuation as an example 1 were performed first, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, anhydrous salt-sized magnesium in an example 1 It replaces with 0.281g (2.95 millimol), and is anhydrous salt-sized calcium. Except having used 0.327g (2.95 millimol), the same actuation as an example 1 was performed, and the calcium salt of a bridge formation copolymer was obtained. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was 21.0 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0048] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, germinating rate It was 100%.



Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0049] [Example 3] Except that the charge of the 43-% of the weight sodium methacrylate water solution and methoxy polyethylene-glycol methacrylate in an example 1 is changed and it was made for the mole ratio of the methacrylic-acid component in a sodium methacrylate water solution and methoxy polyethylene-glycol methacrylate to be set to 5:95, reaction and actuation were performed under the same conditions as an example 1, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, the same actuation as an example 2 was performed, and the calcium salt of a bridge formation copolymer was obtained. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was 17.2 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0050] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 92%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0051] [Example 4] Except that the charge of the 43-% of the weight sodium methacrylate water solution and methoxy polyethylene-glycol methacrylate in an example 1 is changed and it was made for the mole ratio of the methacrylic-acid component in a sodium methacrylate water solution and methoxy polyethylene-glycol methacrylate to be set to 95:5, reaction and actuation were performed under the same conditions as an example 1, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, the same actuation as an example 2 was performed, and the calcium salt of a bridge formation copolymer was obtained. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, It was 5.4 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0052] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 94%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0053] [Example 5] The 43-% of the weight sodium methacrylate water solution in an example 1, And it replaces with the methoxy polyethylene-glycol methacrylate whose number of average addition mols of ethyleneoxide is nine mols. The methoxy polyethylene-glycol methacrylate a 43-% of the weight acrylic-acid sodium water solution and whose number of average addition mols of ethyleneoxide are 23 mols is used. And the acrylic-acid component in an acrylic-acid sodium water solution, Except having taught both so that a mole ratio with methoxy polyethylene-glycol methacrylate might be set to 80:20, reaction and actuation were performed under the same conditions as an example 1, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, the same actuation as an example 2 was performed, and the calcium salt of a bridge formation copolymer was obtained. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was 18.8 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0054] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 96%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0055] [Example 6] It replaced with the methoxy polyethylene-glycol methacrylate in an example 1 whose number of average addition mols of ethyleneoxide is nine mols, and using the butoxy polyethylene-glycol methacrylate whose number of average addition mols of ethyleneoxide is 50 mols, except having taught both so that the mole ratio of the methacrylic-acid component in a sodium methacrylate water solution and butoxy polyethylene-glycol methacrylate might be set to 80:20, reaction and actuation were performed under the same conditions as an example 1, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, the same actuation as an example 2 was performed, and the calcium salt of a bridge formation copolymer was obtained. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material

for plantation arts, was 14.1 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0056] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 96%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0057] [Example 7] 35-% of the weight methacrylic-acid magnesium water solution which is the alkaline-earth-metal salt of an anionic monomer at the same reactor as an example 1 The 203 sections, methoxy polyethylene-glycol methacrylate The 169 sections, the ion-exchange-water 23.2 section, and the polyethylene-glycol diacrylate 0.41 section were taught, and it considered as reaction mixture. The number of average addition mols of the ethyleneoxide in the above-mentioned methoxy polyethylene-glycol methacrylate is nine mols. Moreover, the number of average addition mols of the ethyleneoxide in polyethylene-glycol diacrylate is eight mols.

[0058] That is, both were taught so that the concentration of the methacrylic-acid component in a methacrylic-acid magnesium water solution and the monomer component in reaction mixture while making it a mole ratio with methoxy polyethylene-glycol methacrylate set to 67:33 might become 60 % of the weight. Moreover, polyethylene-glycol diacrylate was taught so that the rate to the above-mentioned monomer component might become 0.12-mol %. In addition, since magnesium is a divalent metal, per mol and two mols of methacrylic-acid components will be contained in the above-mentioned methacrylic-acid magnesium.

[0059] Next, while blowing nitrogen gas into the above-mentioned reaction mixture and driving out dissolved oxygen, nitrogen inert gas replacement of the system of reaction was carried out. Then, 10 % of the weight after carrying out the temperature up of the temperature of reaction mixture to 40 degrees C using a water bath The 2 and 2'-azobis (2-amidinopropane) hydrochloride water-solution 4.44 section was added. And stirring was stopped after stirring and mixing this reaction mixture. Then, the polymerization reaction was started immediately. The 2 and 2'-azobis (2-amidinopropane) hydrochloride was added so that the rate to a monomer component might become 0.15-mol %.

[0060] In the above-mentioned polymerization reaction, 38 minutes after starting the reaction, the temperature of reaction mixture became 93 degrees C, and reached the peak. In the meantime, the temperature up of the temperature of a water bath was suitably carried out so that it might become almost equal to the temperature of reaction mixture. After the temperature of reaction mixture reached the peak, the temperature of a water bath was maintained at 80 degrees C, and this reaction mixture was riped for 30 minutes. The obtained water gel polymer was taken out after reaction termination, and it cracked in the shape of a particle.

[0061] The cracked water gel polymer was dried at the bottom of a nitrogen air current, and 150 degree C for 1 hour using the hot blast circulation type dryer. Subsequently, it filtered, after mixing the ion-exchange-water 3000 section in this dry matter 1 section and stirring for 1 hour. After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using the table-top-type grinder. This obtained the magnesium salt of a powder-like bridge formation copolymer. The obtained bridge formation copolymer (magnesium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was 18.9 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0062] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 86%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0063] [Example 8] 10-% of the weight methacrylic-acid calcium water solution which is the alkaline-earth-metal salt of an anionic monomer at the same reactor as an example 1 The 313 sections, the methoxy polyethylene-glycol methacrylate 68.7 section, the ion-exchange-water 16.9 section, and the polyethylene-glycol diacrylate 0.17 section were taught, and it considered as reaction mixture. The number of average addition mols of the ethyleneoxide in the above-mentioned methoxy polyethylene-glycol methacrylate is nine mols. Moreover, the number of average addition mols of the ethyleneoxide



in polyethylene-glycol diacrylate is eight mols.

[0064] That is, both were taught so that the concentration of the methacrylic-acid component in a methacrylic-acid calcium water solution and the monomer component in reaction mixture while making it a mole ratio with methoxy polyethylene-glycol methacrylate set to 67:33 might become 25 % of the weight. Moreover, polyethylene-glycol diacrylate was taught so that the rate to the above-mentioned monomer component might become 0.12-mol %. In addition, since calcium is a divalent metal, per mol and two mols of methacrylic-acid components will be contained in the above-mentioned methacrylic-acid calcium.

[0065] Next, while blowing nitrogen gas into the above-mentioned reaction mixture and driving out dissolved oxygen, nitrogen inert gas replacement of the system of reaction was carried out. Then, 10 % of the weight after carrying out the temperature up of the temperature of reaction mixture to 50 degrees C using a water bath The 2 and 2'-azobis (2-amidinopropane) hydrochloride water-solution 1.21 section was added. And stirring was stopped after stirring and mixing this reaction mixture. Then, the polymerization reaction was started immediately. The 2 and 2'-azobis (2-amidinopropane) hydrochloride was added so that the rate to a monomer component might become 0.15-mol %.

[0066] In the above-mentioned polymerization reaction, 60 minutes after starting the reaction, the temperature of reaction mixture became 58 degrees C, and reached the peak. In the meantime, the temperature up of the temperature of a water bath was suitably carried out so that it might become almost equal to the temperature of reaction mixture. After the temperature of reaction mixture reached the peak, the temperature up of the temperature of a water bath was carried out to 80 degrees C, and this reaction mixture was riped for 60 minutes. The obtained water gel polymer was taken out after reaction termination, and it cracked in the shape of a particle.

[0067] The cracked water gel polymer was dried at the bottom of a nitrogen air current, and 150 degree C for 1 hour using the hot blast circulation type dryer. Subsequently, it filtered, after mixing the ion-exchange-water 3000 section in this dry matter 1 section and stirring for 1 hour. After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using the table-top-type grinder. This obtained the calcium salt of a powder-like bridge formation copolymer. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was 63.0 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0068] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 98%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0069] [Example 1 of a comparison] The same reaction and actuation as an example 1 were performed first, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, it filtered, after mixing the ion-exchange-water 3000 section in this bridge formation copolymer 1 section and stirring for 1 hour. After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using the table-top-type grinder. This obtained the sodium salt of a powder-like bridge formation copolymer, i.e., the water retention material for plantation arts for a comparison. The liquid absorption scale factor of the obtained water retention material for plantation arts for a comparison was 22.6 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts for a comparison, the liquid absorption scale factor was indicated to Table 2.

[0070] Next, the engine performance of the water retention material for plantation arts for the above-mentioned comparison was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 66%. Moreover, the growth situation is poor and the radish withered and died. These evaluation result was indicated to Table 3.

[0071] [Example 2 of a comparison] It filtered, after mixing the ion-exchange-water 3000 section in the acrylic-acid sodium-acrylamide cross-linked-polymer 1 commercial section and stirring for 1 hour. The mole ratio of the acrylic-acid component in the above-mentioned cross linked polymer and acrylamide was 30:70.

[0072] After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using the table-top-type grinder. This obtained the sodium salt of a powder-like bridge formation copolymer (cross linked polymer), i.e., the water retention material for plantation arts for a comparison. The liquid absorption scale factor of the obtained water retention material for plantation arts for a comparison was 25.3 g/g. The liquid absorption scale factor etc. was indicated to Table 2.

[0073] Next, the engine performance of the water retention material for plantation arts for the above-mentioned comparison was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 58%. Moreover, the growth situation is poor and the radish withered and died. These evaluation result was indicated to Table 3.

[0074] [Example 3 of a comparison] It filtered, after mixing the ion-exchange-water 3000 section in the acrylic-acid sodium cross-linked-polymer 1 commercial section and stirring for 1 hour. After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using the table-top-type grinder. This obtained the sodium salt of a powder-like polymer, i.e., the water retention material for plantation arts for a comparison. Liquid absorption scale factor of the obtained water retention material for plantation arts for a comparison It was 3.8 g/g. The liquid absorption scale factor etc. was indicated to Table 2.

[0075] Next, the engine performance of the water retention material for plantation arts for the above-mentioned comparison was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 54%. Moreover, the growth situation is poor and the radish withered and died. These evaluation result was indicated to Table 3.

[0076] [Example 4 of a comparison] To the same reactor as an example 1, it is a 40-% of the weight acrylic-acid magnesium water solution. The 100.2 sections, 40-% of the weight acrylamide water solution As the 199.8 sections, the ion-exchange-water 73.8 section, and a cross linking agent The 1.5-% of the weight N and N-methylenebis acrylamide water-solution 16.5 section was taught, and it considered as reaction mixture. That is, both were taught so that the concentration of the sum total of the above-mentioned acrylic-acid component and acrylamide in reaction mixture, i.e., the concentration of a monomer component, might become 30 % of the weight, while making it the mole ratio of the acrylic-acid component in an acrylic-acid magnesium water solution and acrylamide set to 30:70. Moreover, the rate to the above-mentioned monomer component N and N-methylenebis acrylamide It taught so that it might become 0.1-mol %.

[0077] Next, while blowing nitrogen gas into the above-mentioned reaction mixture and driving out dissolved oxygen, nitrogen inert gas replacement of the system of reaction was carried out. Then, after carrying out the temperature up of the temperature of reaction mixture to 20 degrees C using a water bath, the 10-% of the weight sodium persulfate water-solution 4.88 as a polymerization initiator section and the 1-% of the weight sodium L-ascorbate water-solution 4.81 section were added. And stirring was stopped after stirring and mixing this reaction mixture. Then, the polymerization reaction was started immediately. Sodium persulfate was added so that the rate to a monomer component might become 0.15-mol %. Moreover, sodium L-ascorbate was added so that the rate to a monomer component might become 0.02-mol %.

[0078] In the above-mentioned polymerization reaction, 3 minutes after starting a reaction, the temperature of reaction mixture It became 108 degrees C and the peak was reached. In the meantime, the temperature up of the temperature of a water bath was suitably carried out so that it might become almost equal to the temperature of reaction mixture, until it became 90 degrees C. After the temperature of reaction mixture reached the peak, the temperature of a water bath was maintained at 80 degrees C, and this reaction mixture was riped for 30 minutes. The obtained water gel polymer was taken out after reaction termination, and it cracked in the shape of a particle.

[0079] The cracked water gel polymer was dried at the bottom of a nitrogen air current, and 150 degree C for 1 hour using the hot blast circulation type dryer. Subsequently, it filtered, after mixing the ion-exchange-water 3000 section in this dry matter 1 section and stirring for 1 hour. After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using

the table-top-type grinder. This obtained the magnesium salt of a powder-like bridge formation copolymer, i.e., the water retention material for plantation arts for a comparison. The liquid absorption scale factor of the obtained water retention material for plantation arts for a comparison was 19.2 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts for a comparison, the liquid absorption scale factor was indicated to Table 2.

[0080] Next, the engine performance of the water retention material for plantation arts for the above-mentioned comparison was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 82%. Moreover, the growth situation is poor and the radish withered and died. These evaluation result was indicated to Table 3.

[0081]

[Table 1]

|             |   | アニオン性単量体         | ノニオン性単量体                                      | 単量体成分の<br>モル比 | 塩の種類    | 吸液倍率<br>(g/g) |
|-------------|---|------------------|---|---------------|---------|---------------|
| 実<br>施<br>例 | 1 | メタクリル酸<br>ナトリウム  | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 9 モル)  | 67/33         | マグネシウム塩 | 15.9          |
|             | 2 | 同 上              | 同 上   | 67/33         | カルシウム塩  | 21.0          |
|             | 3 | 同 上              | 同 上   | 5/95          | カルシウム塩  | 17.2          |
|             | 4 | 同 上              | 同 上   | 95/5          | カルシウム塩  | 5.4           |
|             | 5 | アクリル酸<br>ナトリウム   | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 23 モル) | 80/20         | カルシウム塩  | 18.8          |
|             | 6 | メタクリル酸<br>ナトリウム  | ブトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 50 モル) | 80/20         | カルシウム塩  | 14.1          |
|             | 7 | メタクリル酸<br>マグネシウム | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 9 モル)  | 67/33         | マグネシウム塩 | 18.9          |
|             | 8 | メタクリル酸<br>カルシウム  | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 9 モル)  | 67/33         | カルシウム塩  | 63.0          |

[0082]

[Table 2]

|             |   | アニオン性単量体        | ノニオン性単量体                                     | 単量体成分の<br>モル比 | 塩の種類    | 吸液倍率<br>(g/g) |
|-------------|---|-----------------|--|---------------|---------|---------------|
| 比<br>較<br>例 | 1 | メタクリル酸<br>ナトリウム | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 9 モル) | 67/33         | ナトリウム塩  | 22.6          |
|             | 2 | アクリル酸<br>ナトリウム  | アクリルアミド                                      | 30/70         | ナトリウム塩  | 25.3          |
|             | 3 | アクリル酸<br>ナトリウム  | ———  | ———           | ナトリウム塩  | 3.8           |
|             | 4 | アクリル酸<br>マグネシウム | アクリルアミド                                      | 30/70         | マグネシウム塩 | 19.2          |

[0083]

[Table 3]

|     |   | 発芽率<br>(%) | 生育状況   |
|-----|---|------------|--------|
| 実施例 | 1 | 88         | 良好     |
|     | 2 | 100        | 良好     |
|     | 3 | 92         | 良好     |
|     | 4 | 94         | 良好     |
|     | 5 | 96         | 良好     |
|     | 6 | 96         | 良好     |
|     | 7 | 86         | 良好     |
|     | 8 | 98         | 良好     |
| 比較例 | 1 | 66         | 不良(枯死) |
|     | 2 | 58         | 不良(枯死) |
|     | 3 | 54         | 不良(枯死) |
|     | 4 | 82         | 不良(枯死) |

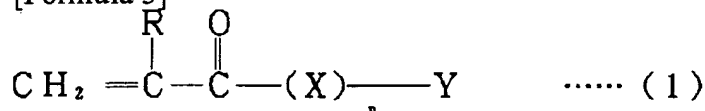
[0084] It turns out that the water retention material for plantation arts concerning this example has a high liquid absorption scale factor, therefore it excels in water retention, and excels in the compatibility over a vegetable root so that clearly from Table 1 and 3. On the other hand, although the water retention material for plantation arts for a comparison concerning the examples 1, 2, and 4 of a comparison has a high liquid absorption scale factor and it excels in water retention so that clearly from Table 2 and 3, it turns out that it is inferior to the compatibility over a vegetable root, and a sprout, rooting, growth, etc. are checked. Moreover, while the water retention material for plantation arts for a comparison concerning the example 3 of a comparison has a low liquid absorption scale factor and it is inferior to water retention in it, it turns out that it is inferior also to the compatibility over a vegetable root.

[0085]

[Effect of the Invention] The water retention material for plantation arts of this invention according to claim 1 is an anionic monomer and a general formula (1) as mentioned above.

[0086]

[Formula 3]



[0087] (R expresses a hydrogen atom or a methyl group among a formula, and X expresses the oxy-alkylene group of the carbon numbers 2-4 whose mole fractions of the oxyethylene radical to all oxy-alkylene groups are more than 50 mol %.) Y expresses the alkoxy group of carbon numbers 1-5, a phenoxy group, or the oxy-alkylphenyl radical that has 1-3 alkyl groups of carbon numbers 1-9 as a substituent. n -- an average -- the integer of 3-100 -- expressing -- it is a configuration containing the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component containing the nonionic monomer expressed. Moreover, the water retention material for plantation arts of this invention according to claim 2 is the configuration that alkaline earth metal is calcium, as mentioned above.

[0088] The effectiveness that the water retention material for plantation arts which whose liquid absorption scale factor was high, was excellent in water retention by this, and was excellent in the compatibility over a vegetable root can be offered is done so.

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[Translation done.]

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TECHNICAL FIELD

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[Field of the Invention] This invention relates to the water retention material for plantation arts offered suitable for environmental preservation, such as tree planting of a desert and prevention of desertification of soil, or a kitchen garden.

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PRIOR ART

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[Description of the Prior Art] Conventionally, the water retention material which consists of anion mold polymers, such as the Nonion mold polymers, such as an acrylamide system polymer, or an acrylic-acid system polymer, is known. However, although the Nonion mold polymer has high compatibility to a vegetable root, it has the fault that a liquid absorption scale factor is low and inferior to water retention. Moreover, although an anion mold polymer has a high liquid absorption scale factor and being excelled in water retention, since the bad influence of it being inferior to the compatibility over a vegetable root, and checking a sprout, rooting, growth, etc. is done, it has the fault that vegetation tends to wither. For this reason, the above-mentioned water retention material is unsuitable although offered as water retention material for plantation arts.

[0003] Then, the water retention material for plantation arts which consists of a bridge formation copolymer led from the monomer component containing an anionic monomer and a nonionic monomer is proposed (JP,3-8736,B, JP,3-149288,A).

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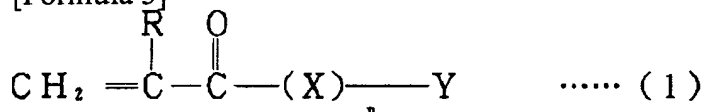
EFFECT OF THE INVENTION

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[Effect of the Invention] The water retention material for plantation arts of this invention according to claim 1 is an anionic monomer and a general formula (1) as mentioned above.

[0086]

[Formula 3]



[0087] (R expresses a hydrogen atom or a methyl group among a formula, and X expresses the oxy-alkylene group of the carbon numbers 2-4 whose mole fractions of the oxyethylene radical to all oxy-alkylene groups are more than 50 mol %.) Y expresses the alkoxy group of carbon numbers 1-5, a phenoxy group, or the oxy-alkylphenyl radical that has 1-3 alkyl groups of carbon numbers 1-9 as a substituent. n -- an average -- the integer of 3-100 -- expressing -- it is a configuration containing the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component containing the nonionic monomer expressed. Moreover, the water retention material for plantation arts of this invention according to claim 2 is the configuration that alkaline earth metal is calcium, as mentioned above.

[0088] The effectiveness that the water retention material for plantation arts which whose liquid absorption scale factor was high, was excellent in water retention by this, and was excellent in the compatibility over a vegetable root can be offered is done so.

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[Translation done.]



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**TECHNICAL PROBLEM**

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[Problem(s) to be Solved by the Invention] However, also in the above-mentioned conventional water retention material for plantation arts, it is hard to say that the balance of water retention and the compatibility over a vegetable root is inadequate, and it has the engine performance with which are satisfied of both. Therefore, it is anxious for the water retention material for plantation arts which was excellent in water retention and was excellent in the compatibility over a vegetable root.

[0005] It is in offering the water retention material for plantation arts which this invention was made in view of the above-mentioned conventional trouble, and excelled [ purpose / the ] in water retention, and was excellent in the compatibility over a vegetable root.

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[Translation done.]

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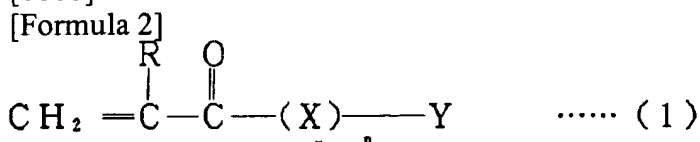
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## MEANS

[Means for Solving the Problem] As a result of inquiring wholeheartedly that the above-mentioned purpose should be attained, the water retention material for plantation arts containing the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component containing an anionic monomer and the nonionic monomer of specific structure has a high liquid absorption scale factor, therefore an invention-in-this-application person etc. excels [ material ] in water retention, moreover finds out having high compatibility to a vegetable root, and came to complete this invention.

[0007] That is, the water retention material for plantation arts of invention according to claim 1 is an anionic monomer and a general formula (1), in order to solve the above-mentioned technical problem.

[0008]



[0009] (R expresses a hydrogen atom or a methyl group among a formula, and X expresses the oxy-alkylene group of the carbon numbers 2-4 whose mole fractions of the oxyethylene radical to all oxy-alkylene groups are more than 50 mol %.) Y expresses the alkoxy group of carbon numbers 1-5, a phenoxy group, or the oxy-alkylphenyl radical that has 1-3 alkyl groups of carbon numbers 1-9 as a substituent. n -- an average -- the integer of 3-100 -- expressing -- it is characterized by including the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component containing the nonionic monomer expressed.

[0010] The water retention material for plantation arts of invention according to claim 2 is characterized by alkaline earth metal being calcium in the water retention material for plantation arts according to claim 1, in order to solve the above-mentioned technical problem.

[0011] According to the above-mentioned configuration, the water retention material for plantation arts contains the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component containing an anionic monomer and the nonionic monomer of specific structure. The water retention material for plantation arts which whose liquid absorption scale factor was high, was excellent in water retention by this, and was excellent in the compatibility over a vegetable root can be offered.

[0012] This invention is explained in detail below. The water retention material for plantation arts concerning this invention contains the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component containing an anionic monomer and the nonionic monomer of specific structure. The above-mentioned alkaline earth metal has magnesium and more desirable calcium, and especially its calcium is desirable. In addition, the above-mentioned monomer component may contain other monomers other than an anionic monomer and a nonionic monomer within limits which do not spoil the engine performance as water retention material for plantation arts.

[0013] The above-mentioned anionic monomer is not especially limited like the after-mentioned that what is necessary is just the monomer which can form alkaline earth metal and a salt. As an anionic

monomer, specifically For example, an acrylic acid (meta), Partial saturation monocarboxylic acid system monomers and these alkali-metal salts, such as a crotonic acid; A maleic acid, Partial saturation dicarboxylic acid system monomers and these alkali-metal salts, such as a fumaric acid, an itaconic acid, and a citraconic acid; A vinyl sulfonic acid, An allyl compound sulfonic acid, a metallyl sulfonic acid, a styrene sulfonic acid, 2-acrylamide - isobutane sulfonic acid, Sulfoethyl (meta) acrylate, sulfopropyl (meta) acrylate, Partial saturation sulfonic-acid system monomers and these alkali-metal salts, such as 2-hydroxy sulfopropyl (meta) acrylate; (meta) Acrylamide methane phosphonic acid, 2-(meta) acrylamide Partial saturation phosphonic acid system monomers, these alkaline-earth-metal salts, etc., such as - isobutane phosphonic acid, are mentioned. These anionic monomer may be used independently, and may mix two or more kinds suitably, and may be used. Partial saturation monocarboxylic acid system monomers and these alkaline-earth-metal salts are more desirable among the monomers of the above-mentioned instantiation, acrylic acids (meta) and these alkaline-earth-metal salts are still more desirable, and a methacrylic acid and especially its alkaline-earth-metal salt are desirable. In addition, an anionic monomer has the function which gives moderate gel strength to this water retention material for plantation arts while raising the liquid absorption scale factor of the water retention material for plantation arts obtained. And by having moderate gel strength, the water retention material for plantation arts is swollen in soil, forms an opening, and gives permeability to this soil.

[0014] As a nonionic monomer expressed with said general formula (1) Specifically For example, methoxy polyethylene-glycol monochrome (meta) acrylate, Ethoxy polyethylene-glycol monochrome (meta) acrylate, butoxy polyethylene-glycol monochrome (meta) acrylate, Methoxy polyethylene-glycol polypropylene-glycol monochrome (meta) acrylate, Methoxy polyethylene-glycol polybutylene glycol monochrome (meta) acrylate, Ethoxy polyethylene-glycol polypropylene-glycol monochrome (meta) acrylate, Ethoxy polyethylene-glycol polybutylene glycol monochrome (meta) acrylate, Acrylic ester (meta) system monomers, such as phenoxy polyethylene-glycol monochrome (meta) acrylate and benzyloxy polyethylene-glycol monochrome (meta) acrylate, are mentioned. These nonionic monomer may be used independently, and may mix two or more kinds suitably, and may be used. Methoxy polyethylene-glycol methacrylate is more desirable among the monomers of the above-mentioned instantiation. Moreover, when using methoxy polyethylene-glycol methacrylate as a nonionic monomer, the number of average addition mols of ethyleneoxide has desirable within the limits of five mols - 50 mols. That is, when Y is a methoxy group, within the limits of n of 5-50 is desirable [ X in a general formula (1) is an oxyethylene radical, and R is a methyl group, and ]. In addition, the polyoxyalkylene chain in a nonionic monomer has the function which raises the compatibility over the root of the vegetation of the water retention material for plantation arts obtained, the salt atmosphere of this water retention material for plantation arts, etc.

[0015] Although especially the rate of the anionic monomer in the above-mentioned the ratio of an anionic monomer and a nonionic monomer, i.e., bridge formation copolymer component, is not limited, 5 % of the weight - 95% of the weight of its within the limits is more desirable, and 10 % of the weight - 70% of the weight of its within the limits is still more desirable. When there are few rates of an anionic monomer than 5 % of the weight, the liquid absorption scale factor of the alkaline-earth-metal salt of a bridge formation copolymer becomes low. The gel strength of the water retention material for plantation arts obtained falls, and it becomes impossible moreover, to give permeability to soil. When there are more rates of an anionic monomer than 95 % of the weight, there is an inclination for the leached moiety (meltable component) in the bridge formation copolymer obtained to increase. Moreover, the compatibility over the root of the vegetation of the water retention material for plantation arts obtained and the salt atmosphere of this water retention material for plantation arts fall. Therefore, there is a possibility that the water retention material for plantation arts equipped with the physical properties for which it asks may not be obtained.

[0016] The approach of manufacturing the alkaline-earth-metal salt of a bridge formation copolymer After making for example, not the thing limited especially but \*\* anionic monomer, and chlorides, such as a calcium chloride and a magnesium chloride, react and forming the alkaline-earth-metal salt of an anionic monomer, The approach and \*\* anionic monomer to which copolymerization of the nonionic

monomer is added and carried out, The approach and \*\* anionic monomer to which copolymerization of the nonionic monomer is added and carried out after making hydroxides, such as a calcium hydroxide and a magnesium hydroxide, react and forming the alkaline-earth-metal salt of an anionic monomer, After making carbonates, such as a calcium carbonate and a magnesium carbonate, react and forming the alkaline-earth-metal salt of an anionic monomer, After carrying out copolymerization of the approach and \*\* anionic monomer to which copolymerization of the nonionic monomer is added and carried out, and the nonionic monomer, After carrying out copolymerization of the approach and \*\* anionic monomer which add the above-mentioned chloride and form an alkaline-earth-metal salt, and the nonionic monomer, After carrying out copolymerization of the approach and \*\* anionic monomer which add the above-mentioned hydroxide and form an alkaline-earth-metal salt, and the nonionic monomer, various approaches, such as the approach of adding the above-mentioned carbonate and forming an alkaline-earth-metal salt, are employable. Moreover, after mixing an anionic monomer, a nonionic monomer, and a chloride, an above-mentioned hydroxide or an above-mentioned carbonate, copolymerization can be carried out and the alkaline-earth-metal salt of a bridge formation copolymer can also be manufactured. The approach of the approach of \*\* - \*\* is more desirable among these approaches, the approach of the approach of \*\* - \*\* is still more desirable, and especially the approach of \*\* is desirable. Moreover, when adopting the approach of the above-mentioned \*\*, especially a chloride has a desirable calcium chloride.

[0017] Furthermore, once forming the alkali-metal salt of a bridge formation copolymer, the alkaline-earth-metal salt of a bridge formation copolymer can also be manufactured by permuting this alkali-metal salt by the alkaline-earth-metal salt. In this case, molecular weight of a bridge formation copolymer can be further enlarged by carrying out copolymerization of the alkali-metal salt of an anionic monomer, and the nonionic monomer, and forming the alkali-metal salt of a bridge formation copolymer. In addition, sodium of alkali metal is more desirable.

[0018] Although the alkaline-earth-metal salt of the bridge formation copolymer in the invention in this application is not clear about the reason whose leached moiety decreases compared with alkali-metal salts, such as sodium salt and potassium salt, it guesses as follows. That is, it is guessed that it is for the solubility of a fusibility polymer to fall as a result of constructing a bridge over this fusibility polymer two-dimensional or in three dimensions with alkaline earth metal although a leached moiety uses a fusibility polymer as a principal component.

[0019] Well-known various approaches, for example, a solution polymerization method, a suspension-polymerization method, an opposition suspension-polymerization method or a casting polymerization method, a thin film polymerization method, a spray polymerization method, etc. can be conventionally used for a polymerization method. In addition, although especially the stirring approach at the time of performing a polymerization reaction is not limited, it is more desirable to stir subdividing the gel bridge formation copolymer (it mentioning later) to generate according to this double arm mold kneader's shearing force using a double arm mold kneader as stirring equipment.

[0020] Specifically as a dispersant suitable when adopting an opposition suspension-polymerization method, carboxyl group content polymers, such as cellulose ester, such as a sorbitan fatty acid ester, sucrose fatty acid ester, a glycerine fatty acid ester, polyglyceryl fatty acid ester, ethyl cellulose, and cellulose acetate, cellulose ether, and an alpha olefin-maleic-anhydride copolymer, etc. are mentioned. These dispersants may be used independently, and may mix two or more kinds suitably, and may be used. In addition, especially the hydrophobic organic solvent offered when adopting an opposition suspension-polymerization method is not limited.

[0021] Although it is not limited, since low-temperature one becomes large, its molecular weight of a bridge formation copolymer is comparatively desirable, and since a polymerization reaction completes especially reaction temperature, within the limits of 20 degrees C - 100 degree C is still more desirable [ reaction temperature ]. In addition, what is necessary is just to set up reaction time suitably according to the class (property) of reaction temperature, a monomer component, a polymerization initiator, a solvent, etc., etc., combination, the amount used, etc. so that the above-mentioned polymerization reaction may be completed.

[0022] A polymerization initiator can be used in case copolymerization of the monomer component is carried out. Specifically as this polymerization initiator, they are peroxides, such as a hydrogen peroxide, benzoyl peroxide, and cumene hydroperoxide.; Azo compounds, such as a 2 and 2'-azobisisobutyronitril, 2, 2'-azobis (2-amidinopropane) hydrochloride; radical generating agents (radical polymerization initiator), such as persulfate, such as ammonium persulfate, sodium persulfate, and potassium persulfate, etc. are mentioned. These polymerization initiators may be used independently, and may mix two or more kinds suitably, and may be used. Furthermore, the redox system initiator which comes to combine these radical generating agent and reducing agents, such as a sodium hydrogensulfite, and L-ascorbic acid (salt), ferrous salt, may be used. In addition, instead of using a polymerization initiator, a radiation, an electron ray, ultraviolet rays, etc. may be irradiated, and a polymerization initiator and the exposure of these radiations, an electron ray, ultraviolet rays, etc., etc. may be used together.

[0023] Although especially the amount of the polymerization initiator used is not limited, 0.001 % of the weight - 10% of the weight of its within the limits is more desirable to a monomer component, and 0.01 % of the weight - 1% of the weight of its within the limits is still more desirable. Moreover, although especially the amount of the reducing agent used in the case of using a redox system initiator is not limited, its within the limits of 0.01-5 is more desirable to a radical generating agent at a weight ratio, and its within the limits of 0.05-2 is still more desirable.

[0024] Moreover, in case copolymerization of the monomer component is carried out, a cross linking agent may be used if needed. As this cross linking agent, specifically For example, a divinylbenzene, ethylene GURIKORUJI (meta) acrylate, Diethylene GURIKORUJI (meta) acrylate, TORIECHIRENGURIKORUJI (meta) acrylate, Propylene GURIKORUJI (meta) acrylate, polyethylene GURIKORUJI (meta) acrylate, TORIMECHI roll pro pantry (meta) acrylate, pen TAERISURITORUJI (meta) acrylate, Pen TAERISURITORUTORI (meta) acrylate, N, and N-methylenebis (meta) acrylamide, An isocyanuric acid triaryl, trimethylol propane diaryl ether, etc., The compound which has two or more ethylene system partial saturation radicals in 1 molecule; Ethylene glycol, A diethylene glycol, triethylene glycol, a polyethylene glycol, A glycerol, polyglycerin, propylene glycol, a polypropylene glycol, Polyvinyl alcohol, pentaerythritol, diethanolamine, Triethanolamine, sorbitol, sorbitan, a glucose, mannite, Polyhydric alcohol, such as Manni Tan, cane sugar, and grape sugar; Ethylene glycol diglycidyl ether, Polyethylene glycol diglycidyl ether, glycerol diglycidyl ether, Propylene glycol diglycidyl ether, polypropylene glycol diglycidyl ether, Neopentyl glycol diglycidyl ether, 1, 6-hexanediol diglycidyl ether, The Pori epoxy compounds, such as trimethylol propane diglycidyl ether, trimethylolpropane triglycidyl ether, and glycerol triglycidyl ether, etc. are mentioned. These cross linking agents may be used independently, and they may be mixed suitably and two or more kinds may be used for them.

[0025] Since the crosslinking density of a bridge formation copolymer is controllable by using a cross linking agent, the water retention ability (for example, liquid absorption scale factor etc.) of the water retention material for plantation arts can be adjusted. What is necessary is not to limit especially the amount of the cross linking agent used, and just to set it up suitably by the class of a monomer component or cross linking agent, crosslinking density (that is, water retention ability), gel strength which are used for example, for which it asks, etc. specifically, about 0.0005 to 0.02 within the limits has [ the amount of the cross linking agent used ] a more desirable mole ratio to a monomer component - within the limits of 0.001-0.01 is still more desirable. In addition, when using polyhydric alcohol as a cross linking agent, they are after a polymerization reaction and a bridge formation copolymer. It is desirable to heat-treat at 150 degrees C - 250 degree C. Moreover, when using the Pori epoxy compound as a cross linking agent, it is desirable after a polymerization reaction to heat-treat a bridge formation copolymer at 50 degrees C - 250 degree C.

[0026] Furthermore, in case copolymerization of the monomer component is carried out, a solvent may be used if needed. Specifically as this solvent, aquosity solvents, such as a water; cyclohexane, a toluene; methanol, ethanol, an acetone, dimethylformamide, and dimethyl sulfoxide, etc. are mentioned. These solvents may be used independently, and may mix two or more kinds suitably, and may be used.

Since the bridge formation copolymer with still higher compatibility [ as opposed to the root of safety or vegetation in the mixture of water and water, and an aqueous solvent ] etc. among the solvents of the above-mentioned instantiation, i.e., the water retention material for plantation arts, can be manufactured cheaply, it is more desirable. In addition, although especially the concentration of the monomer component in the case of using a solvent is not limited, 20 % of the weight - 80% of the weight of its within the limits is more desirable, and 30 % of the weight - 60% of the weight of its within the limits is still more desirable. While a polymerization reaction is easily controllable by making concentration of the monomer component in the solution containing this monomer component, a polymerization initiator, a cross linking agent, etc. into within the limits of the above, the yield of a bridge formation copolymer can be raised and this bridge formation copolymer can be obtained economically.

[0027] After a polymerization reaction, since it is usually obtained by gel, the alkaline-earth-metal salt of a bridge formation copolymer dries the alkaline-earth-metal salt of this gel bridge formation copolymer, after performing predetermined actuation of washing, a crack, etc. remaining as it is or if needed. Although especially drying temperature is not limited, within the limits of 50 degrees C - 180 degree C being suitable and its within the limits which is 100 degree C to 170 degree C are the optimal. Moreover, after a dry matter operates grinding etc. and carries out grain refining, it performs classification actuation of sieving etc. if needed. It is suitable that the liquid absorption scale factor (it mentions later) to the saturated water solution of slaked lime is within the limits of 10 g/g - 50 g/g preferably within the limits of 5 g/g - 70 g/g as a liquid absorption scale factor of the alkaline-earth-metal salt of a bridge formation copolymer. When a liquid absorption scale factor is under 5 g/g, there is a possibility that water retention may become inadequate. Moreover, when a liquid absorption scale factor exceeds 70 g/g, it tends to be inferior to endurance. In addition, especially a configuration, mean particle diameter, etc. of the water retention material for plantation arts are not limited.

[0028] Furthermore, in order to reduce a leached moiety and to raise further the safety of this water retention material for plantation arts etc. by decreasing a bridge formation copolymer, i.e., the unreacted monomer component which remains to the water retention material for plantation arts, it is desirable to use a reducing agent and to process the alkaline-earth-metal salt of a gel bridge formation copolymer or its dry matter. Specifically as the above-mentioned reducing agent, a sodium sulfite, potassium sulfite, ammonium sulfite, a sodium hydrogensulfite, a potassium hydrogensulfite, hydrogen sulfite ammonium, a sodium thiosulfate, potassium thiosulfate, ammonium thiosulfate, L-ascorbic acid, ammonia, monoethanolamine, a glucose, etc. are mentioned. These reducing agents may be used independently, and may mix two or more kinds suitably, and may be used. A sodium sulfite, a sodium hydrogensulfite, and a sodium thiosulfate are more desirable among the reducing agents of the above-mentioned instantiation. although especially the amount of the reducing agent used is not limited, specifically, about 0.0001 to 0.02 within the limits has a more desirable mole ratio to the used monomer component - within the limits of 0.001-0.01 is still more desirable.

[0029] As for the water retention material for plantation arts concerning this invention, it is desirable to mix and use it to soil, such as soil, by 0.01 % of the weight - 20% of the weight of within the limits. When there is less amount of the water retention material for plantation arts used than 0.01 % of the weight, the effectiveness by using this water retention material for plantation arts is hard to be discovered. On the other hand, since it hardly changes to the effectiveness acquired by using this water retention material for plantation arts within the limits of the above even if it uses the water retention material for plantation arts exceeding 20 % of the weight, it is uneconomical. Moreover, since soil will hold moisture beyond the need, permeability is spoiled and there is a possibility that vegetation may cause the so-called root corrosion.

[0030] Moreover, you may mix with soil, after mixing with soil as it is and making water and liquid fertilizer absorb, in case the water retention material for plantation arts is used. Or this mixture may be mixed with soil after mixing inorganic [ , such as soil, and sand, a compost, ] or organic fine particles, and the water retention material for plantation arts. In addition, the approach which especially the mixed approach of the water retention material for plantation arts to soil is not limited, and sprinkles the water retention material for plantation arts in soil at homogeneity; after sprinkling the water retention material

for plantation arts in soil, the approach of cultivating soil and mixing etc. is employable.

[0031] The water retention material for plantation arts concerning this invention is a configuration containing the alkaline-earth-metal salt of the bridge formation copolymer led from the monomer component which contains an anionic monomer and the nonionic monomer expressed with said general formula (1) as mentioned above. Moreover, the water retention material for plantation arts is the configuration that alkaline earth metal is calcium, as mentioned above.

[0032] The water retention material for plantation arts which whose liquid absorption scale factor was high, was excellent in water retention by this, and was excellent in the compatibility over a vegetable root can be offered. The water retention material for plantation arts can supply the moisture to a root smoothly, and, moreover, checks neither a sprout, nor rooting, growth, etc. Moreover, the water retention material for plantation arts is excellent also in the liquid retaining ability of liquid fertilizer. Furthermore, the water retention material for plantation arts concerning this invention can maintain a high liquid absorption scale factor, when the content of a salt blended and uses it for comparatively high soil, and it shows the water retention ability moreover stabilized with time. This water retention material for plantation arts is offered suitable for environmental preservation, such as tree planting of a desert and prevention of desertification of soil, etc.

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[Translation done.]

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EXAMPLE

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[Example] Hereafter, although an example and the example of a comparison explain this invention to a detail further, this invention is not limited at all by these. In addition, the liquid absorption scale factor of a bridge formation copolymer was measured by the following approaches. Moreover, the "section" given in an example and the example of a comparison shows the "weight section."

[0034] (a) Liquid absorption scale-factor point \*\* of a bridge formation copolymer and the saturated water solution of slaked lime were prepared. Namely, ion exchange water It stirred for 3 hours, after adding the slaked-lime 10 section in the 100 sections and adjusting solution temperature at 20 degrees C. Next, it is a filter paper (No.2) about this water solution, maintaining solution temperature at 20 degrees C. It used and filtered. This prepared the saturated water solution of slaked lime. In addition, this saturated water solution was saved at 20 degrees C.

[0035] Next, about 1g of bridge formation copolymers was put into the tea bag type bag at homogeneity, and it was immersed into the above-mentioned saturated water solution. Weight W1 of a tea bag type bag after pulling up a tea bag type bag after 24-hour standing at 20 degrees C and performing a fixed time amount ridge (g) It measured. Moreover, same actuation is performed without using a bridge formation copolymer, and it is the weight W0 of the tea bag type bag at that time (g). It measured. these weight W1 and W0 from -- the weight (g) of a degree type, and a liquid absorption scale-factor (g/g) = (weight W1(g)-weight W0 (g)) / bridge formation copolymer -- following -- liquid absorption scale factor (g/g) It computed. [ and ] In addition, this liquid absorption scale factor is a balanced value.

[0036] [Example 1] Content volume equipped with a thermometer, nitrogen gas entrainment tubing, and an agitator To the 600ml reactor made from plastics, it is a 43-% of the weight sodium methacrylate water solution as an anionic monomer. The 178.0 sections, methoxy polyethylene-glycol methacrylate as a nonionic monomer The 163.4 sections, the ion-exchange-water 53.9 section as a solvent, and the polyethylene-glycol diacrylate 0.25 section as a cross linking agent were taught, and it considered as reaction mixture. The number of average addition mols of the ethyleneoxide in the above-mentioned methoxy polyethylene-glycol methacrylate is nine mols. Moreover, the number of average addition mols of the ethyleneoxide in polyethylene-glycol diacrylate is eight mols.

[0037] That is, both were taught so that the concentration of the sum total of the above-mentioned methacrylic-acid component and methoxy polyethylene-glycol methacrylate in reaction mixture, i.e., the concentration of a monomer component, might become 60 % of the weight, while making it the mole ratio of the methacrylic-acid component in a sodium methacrylate water solution and methoxy polyethylene-glycol methacrylate set to 67:33. Moreover, polyethylene-glycol diacrylate was taught so that the rate to the above-mentioned monomer component might become 0.05-mol %.

[0038] Next, while blowing nitrogen gas into the above-mentioned reaction mixture and driving out dissolved oxygen, nitrogen inert gas replacement of the system of reaction was carried out. Then, 10 % of the weight as a polymerization initiator after carrying out the temperature up of the temperature of reaction mixture to 40 degrees C using a water bath 2 and 2'-azobis (2-amidinopropane) hydrochloride (Wako Pure Chem Industries make; trade name V-50) water solution The 4.3 sections were added. And stirring was stopped after stirring and mixing this reaction mixture. Then, the polymerization reaction



was started immediately. The 2 and 2'-azobis (2-amidinopropane) hydrochloride was added so that the rate to a monomer component might become 0.15-mol %.

[0039] Since a reaction is started in the above-mentioned polymerization reaction The temperature of reaction mixture became 88 degrees C after 107 minutes, and the peak was reached. In the meantime, the temperature up of the temperature of a water bath was suitably carried out so that it might become almost equal to the temperature of reaction mixture. After the temperature of reaction mixture reached the peak, the temperature of a water bath was maintained at 80 degrees C, and this reaction mixture was riped for 60 minutes. The obtained water gel polymer was taken out after reaction termination, and it cracked in the shape of a particle.

[0040] After drying the cracked water gel polymer at the bottom of a nitrogen air current, and 150 degree C for 1 hour using a hot blast circulation type dryer, the dry matter was ground using the table-top-type grinder, and the sodium salt of a bridge formation copolymer was obtained. The liquid absorption scale factor of the obtained bridge formation copolymer (sodium salt) was measured by the above-mentioned approach. Consequently, the liquid absorption scale factor was 20.9 g/g. Moreover, this bridge formation copolymer had the anionic functional group of perg and 2.95 millimol (equivalent).

[0041] Next, the sodium salt of the above-mentioned bridge formation copolymer was permuted by magnesium salt (alkaline-earth-metal salt). Namely, anhydrous salt-ized magnesium After adding the water solution which comes to dissolve 0.281g (2.95 millimol) in 10g of ion exchange water to 1g of these bridge formation copolymers, it put at 50 degrees C for 1 hour. This obtained water gel. Subsequently, it filtered, after having mixed ion exchange water so that the whole quantity might become this water gel with 1000g, and stirring for 1 hour (the 1st time).

[0042] It filtered, after having filtered (the 2nd time), having mixed ion exchange water so that the whole quantity might be further set to 1000g at this filtration residue after having mixed ion exchange water so that the whole quantity might become the obtained filtration residue (water gel) with 1000g, and stirring for 1 hour, and stirring for 1 hour (the 3rd time). Subsequently, after carrying out reduced pressure drying of the filtration residue (water gel) obtained by the 3rd filtration, the dry matter was ground using the table-top-type grinder. This obtained the magnesium salt of a powder-like bridge formation copolymer.

[0043] It is the following that the obtained bridge formation copolymer is permuted by magnesium salt from sodium salt, and it was made and checked. That is, in the filtrate obtained by the 1st time and the 2nd above-mentioned filtration, in total, magnesium ion is 1.48 millimols and sodium ion is 2.97 millimol \*\* rare \*\*\*\*\*. Moreover, sodium ion was not contained in the filtrate obtained by the 3rd above-mentioned filtration at a magnesium ion list. Therefore, it turned out that the sodium ion with which formation of a salt was presented was eluted in filtrate. Moreover, it turned out that the magnesium ion with which formation of a salt was presented is 1.47 millimols. And it turned out that the number of mols of the magnesium ion with which sodium was univalent metal, magnesium was a divalent metal, and formation of a salt was presented since the bridge formation copolymer had the anionic functional group of 2.95 millimols / g is in agreement with a theoretical value. This checked that the bridge formation copolymer was permuted by magnesium salt from sodium salt.

[0044] The obtained bridge formation copolymer (magnesium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was measured by the above-mentioned approach. Consequently, the liquid absorption scale factor was 15.9 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0045] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated. Namely, river sand (soil) In the 150 sections, the water retention material 0.15 above-mentioned sections for plantation arts and the slaked-lime 5 section were mixed, and this mixture (river sand is only called hereafter) was put [ sections ] into the predetermined seedling raising box at homogeneity. Subsequently, tap water was dropped until water flowed into the above-mentioned river sand out of the seedling raising box (affusion). Then, seeding of 50 grains of seeds (the product made

from TOHOKU, Inc.; name-of-article cherry mate) of a radish was carried out to river sand. And this seedling raising box was left under predetermined conditions after seeding, applying the diffused light, without performing affusion.

[0046] Consequently, after carrying out seeding, the germinating rate (it is only hereafter described as a germinating rate) of the seed in the 3rd day was 88%. Moreover, it was good when viewing estimated the growth situation (it is only hereafter described as a growth situation) of the radish in the 10th day, after carrying out seeding. In addition, the above-mentioned germinating rate was computed based on a degree type and germinating rate (%) = (number of seeds in which seed which budded carried out several/seeding)  $\times$  100. These evaluation result was indicated to Table 3.

[0047] [Example 2] The same reaction and actuation as an example 1 were performed first, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, anhydrous salt-ized magnesium in an example 1 It replaces with 0.281g (2.95 millimol), and is anhydrous salt-ized calcium. Except having used 0.327g (2.95 millimol), the same actuation as an example 1 was performed, and the calcium salt of a bridge formation copolymer was obtained. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was 21.0 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0048] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, germinating rate It was 100%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0049] [Example 3] Except that the charge of the 43-% of the weight sodium methacrylate water solution and methoxy polyethylene-glycol methacrylate in an example 1 is changed and it was made for the mole ratio of the methacrylic-acid component in a sodium methacrylate water solution and methoxy polyethylene-glycol methacrylate to be set to 5:95, reaction and actuation were performed under the same conditions as an example 1, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, the same actuation as an example 2 was performed, and the calcium salt of a bridge formation copolymer was obtained. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was 17.2 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0050] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 92%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0051] [Example 4] Except that the charge of the 43-% of the weight sodium methacrylate water solution and methoxy polyethylene-glycol methacrylate in an example 1 is changed and it was made for the mole ratio of the methacrylic-acid component in a sodium methacrylate water solution and methoxy polyethylene-glycol methacrylate to be set to 95:5, reaction and actuation were performed under the same conditions as an example 1, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, the same actuation as an example 2 was performed, and the calcium salt of a bridge formation copolymer was obtained. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, It was 5.4 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0052] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 94%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0053] [Example 5] The 43-% of the weight sodium methacrylate water solution in an example 1, And it replaces with the methoxy polyethylene-glycol methacrylate whose number of average addition mols of ethyleneoxide is nine mols. The methoxy polyethylene-glycol methacrylate a 43-% of the weight acrylic-acid sodium water solution and whose number of average addition mols of ethyleneoxide are 23 mols is used. And the acrylic-acid component in an acrylic-acid sodium water solution, Except having

taught both so that a mole ratio with methoxy polyethylene-glycol methacrylate might be set to 80:20, reaction and actuation were performed under the same conditions as an example 1, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, the same actuation as an example 2 was performed, and the calcium salt of a bridge formation copolymer was obtained. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was 18.8 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0054] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 96%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0055] [Example 6] It replaced with the methoxy polyethylene-glycol methacrylate in an example 1 whose number of average addition mols of ethyleneoxide is nine mols, and using the butoxy polyethylene-glycol methacrylate whose number of average addition mols of ethyleneoxide is 50 mols, except having taught both so that the mole ratio of the methacrylic-acid component in a sodium methacrylate water solution and butoxy polyethylene-glycol methacrylate might be set to 80:20, reaction and actuation were performed under the same conditions as an example 1, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, the same actuation as an example 2 was performed, and the calcium salt of a bridge formation copolymer was obtained. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was 14.1 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0056] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 96%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0057] [Example 7] 35-% of the weight methacrylic-acid magnesium water solution which is the alkaline-earth-metal salt of an anionic monomer at the same reactor as an example 1 The 203 sections, methoxy polyethylene-glycol methacrylate The 169 sections, the ion-exchange-water 23.2 section, and the polyethylene-glycol diacrylate 0.41 section were taught, and it considered as reaction mixture. The number of average addition mols of the ethyleneoxide in the above-mentioned methoxy polyethylene-glycol methacrylate is nine mols. Moreover, the number of average addition mols of the ethyleneoxide in polyethylene-glycol diacrylate is eight mols.

[0058] That is, both were taught so that the concentration of the methacrylic-acid component in a methacrylic-acid magnesium water solution and the monomer component in reaction mixture while making it a mole ratio with methoxy polyethylene-glycol methacrylate set to 67:33 might become 60 % of the weight. Moreover, polyethylene-glycol diacrylate was taught so that the rate to the above-mentioned monomer component might become 0.12-mol %. In addition, since magnesium is a divalent metal, per mol and two mols of methacrylic-acid components will be contained in the above-mentioned methacrylic-acid magnesium.

[0059] Next, while blowing nitrogen gas into the above-mentioned reaction mixture and driving out dissolved oxygen, nitrogen inert gas replacement of the system of reaction was carried out. Then, 10 % of the weight after carrying out the temperature up of the temperature of reaction mixture to 40 degrees C using a water bath The 2 and 2'-azobis (2-amidinopropane) hydrochloride water-solution 4.44 section was added. And stirring was stopped after stirring and mixing this reaction mixture. Then, the polymerization reaction was started immediately. The 2 and 2'-azobis (2-amidinopropane) hydrochloride was added so that the rate to a monomer component might become 0.15-mol %.

[0060] In the above-mentioned polymerization reaction, 38 minutes after starting the reaction, the temperature of reaction mixture became 93 degrees C, and reached the peak. In the meantime, the temperature up of the temperature of a water bath was suitably carried out so that it might become almost equal to the temperature of reaction mixture. After the temperature of reaction mixture reached the peak, the temperature of a water bath was maintained at 80 degrees C, and this reaction mixture was riped for 30 minutes. The obtained water gel polymer was taken out after reaction termination, and it

cracked in the shape of a particle.

[0061] The cracked water gel polymer was dried at the bottom of a nitrogen air current, and 150 degree C for 1 hour using the hot blast circulation type dryer. Subsequently, it filtered, after mixing the ion-exchange-water 3000 section in this dry matter 1 section and stirring for 1 hour. After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using the table-top-type grinder. This obtained the magnesium salt of a powder-like bridge formation copolymer. The obtained bridge formation copolymer (magnesium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was 18.9 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0062] Next, the engine performance of the above-mentioned water retention material for plantation arts was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 86%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0063] [Example 8] 10-% of the weight methacrylic-acid calcium water solution which is the alkaline-earth-metal salt of an anionic monomer at the same reactor as an example 1 The 313 sections, the methoxy polyethylene-glycol methacrylate 68.7 section, the ion-exchange-water 16.9 section, and the polyethylene-glycol diacrylate 0.17 section were taught, and it considered as reaction mixture. The number of average addition mols of the ethyleneoxide in the above-mentioned methoxy polyethylene-glycol methacrylate is nine mols. Moreover, the number of average addition mols of the ethyleneoxide in polyethylene-glycol diacrylate is eight mols.

[0064] That is, both were taught so that the concentration of the methacrylic-acid component in a methacrylic-acid calcium water solution and the monomer component in reaction mixture while making it a mole ratio with methoxy polyethylene-glycol methacrylate set to 67:33 might become 25 % of the weight. Moreover, polyethylene-glycol diacrylate was taught so that the rate to the above-mentioned monomer component might become 0.12-mol %. In addition, since calcium is a divalent metal, per mol and two mols of methacrylic-acid components will be contained in the above-mentioned methacrylic-acid calcium.

[0065] Next, while blowing nitrogen gas into the above-mentioned reaction mixture and driving out dissolved oxygen, nitrogen inert gas replacement of the system of reaction was carried out. Then, 10 % of the weight after carrying out the temperature up of the temperature of reaction mixture to 50 degrees C using a water bath The 2 and 2'-azobis (2-amidinopropane) hydrochloride water-solution 1.21 section was added. And stirring was stopped after stirring and mixing this reaction mixture. Then, the polymerization reaction was started immediately. The 2 and 2'-azobis (2-amidinopropane) hydrochloride was added so that the rate to a monomer component might become 0.15-mol %.

[0066] In the above-mentioned polymerization reaction, 60 minutes after starting the reaction, the temperature of reaction mixture became 58 degrees C, and reached the peak. In the meantime, the temperature up of the temperature of a water bath was suitably carried out so that it might become almost equal to the temperature of reaction mixture. After the temperature of reaction mixture reached the peak, the temperature up of the temperature of a water bath was carried out to 80 degrees C, and this reaction mixture was riped for 60 minutes. The obtained water gel polymer was taken out after reaction termination, and it cracked in the shape of a particle.

[0067] The cracked water gel polymer was dried at the bottom of a nitrogen air current, and 150 degree C for 1 hour using the hot blast circulation type dryer. Subsequently, it filtered, after mixing the ion-exchange-water 3000 section in this dry matter 1 section and stirring for 1 hour. After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using the table-top-type grinder. This obtained the calcium salt of a powder-like bridge formation copolymer. The obtained bridge formation copolymer (calcium salt), i.e., the liquid absorption scale factor of the water retention material for plantation arts, was 63.0 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts, the liquid absorption scale factor was indicated to Table 1.

[0068] Next, the engine performance of the above-mentioned water retention material for plantation arts

was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 98%. Moreover, the growth situation was good. These evaluation result was indicated to Table 3.

[0069] [Example 1 of a comparison] The same reaction and actuation as an example 1 were performed first, and the sodium salt of a bridge formation copolymer was obtained. Subsequently, it filtered, after mixing the ion-exchange-water 3000 section in this bridge formation copolymer 1 section and stirring for 1 hour. After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using the table-top-type grinder. This obtained the sodium salt of a powder-like bridge formation copolymer, i.e., the water retention material for plantation arts for a comparison. The liquid absorption scale factor of the obtained water retention material for plantation arts for a comparison was 22.6 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts for a comparison, the liquid absorption scale factor was indicated to Table 2.

[0070] Next, the engine performance of the water retention material for plantation arts for the above-mentioned comparison was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 66%. Moreover, the growth situation is poor and the radish withered and died. These evaluation result was indicated to Table 3.

[0071] [Example 2 of a comparison] It filtered, after mixing the ion-exchange-water 3000 section in the acrylic-acid sodium-acrylamide cross-linked-polymer 1 commercial section and stirring for 1 hour. The mole ratio of the acrylic-acid component in the above-mentioned cross linked polymer and acrylamide was 30:70.

[0072] After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using the table-top-type grinder. This obtained the sodium salt of a powder-like bridge formation copolymer (cross linked polymer), i.e., the water retention material for plantation arts for a comparison. The liquid absorption scale factor of the obtained water retention material for plantation arts for a comparison was 25.3 g/g. The liquid absorption scale factor etc. was indicated to Table 2.

[0073] Next, the engine performance of the water retention material for plantation arts for the above-mentioned comparison was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 58%. Moreover, the growth situation is poor and the radish withered and died. These evaluation result was indicated to Table 3.

[0074] [Example 3 of a comparison] It filtered, after mixing the ion-exchange-water 3000 section in the acrylic-acid sodium cross-linked-polymer 1 commercial section and stirring for 1 hour. After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using the table-top-type grinder. This obtained the sodium salt of a powder-like polymer, i.e., the water retention material for plantation arts for a comparison. Liquid absorption scale factor of the obtained water retention material for plantation arts for a comparison It was 3.8 g/g. The liquid absorption scale factor etc. was indicated to Table 2.

[0075] Next, the engine performance of the water retention material for plantation arts for the above-mentioned comparison was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 54%. Moreover, the growth situation is poor and the radish withered and died. These evaluation result was indicated to Table 3.

[0076] [Example 4 of a comparison] To the same reactor as an example 1, it is a 40-% of the weight acrylic-acid magnesium water solution. The 100.2 sections, 40-% of the weight acrylamide water solution As the 199.8 sections, the ion-exchange-water 73.8 section, and a cross linking agent The 1.5-% of the weight N and N-methylenebis acrylamide water-solution 16.5 section was taught, and it considered as reaction mixture. That is, both were taught so that the concentration of the sum total of the above-mentioned acrylic-acid component and acrylamide in reaction mixture, i.e., the concentration of a monomer component, might become 30 % of the weight, while making it the mole ratio of the acrylic-acid component in an acrylic-acid magnesium water solution and acrylamide set to 30:70. Moreover, the rate to the above-mentioned monomer component N and N-methylenebis acrylamide It taught so that it might become 0.1-mol %.

[0077] Next, while blowing nitrogen gas into the above-mentioned reaction mixture and driving out

dissolved oxygen, nitrogen inert gas replacement of the system of reaction was carried out. Then, after carrying out the temperature up of the temperature of reaction mixture to 20 degrees C using a water bath, the 10-% of the weight sodium persulfate water-solution 4.88 as a polymerization initiator section and the 1-% of the weight sodium L-ascorbate water-solution 4.81 section were added. And stirring was stopped after stirring and mixing this reaction mixture. Then, the polymerization reaction was started immediately. Sodium persulfate was added so that the rate to a monomer component might become 0.15-mol %. Moreover, sodium L-ascorbate was added so that the rate to a monomer component might become 0.02-mol %.

[0078] In the above-mentioned polymerization reaction, 3 minutes after starting a reaction, the temperature of reaction mixture It became 108 degrees C and the peak was reached. In the meantime, the temperature up of the temperature of a water bath was suitably carried out so that it might become almost equal to the temperature of reaction mixture, until it became 90 degrees C. After the temperature of reaction mixture reached the peak, the temperature of a water bath was maintained at 80 degrees C, and this reaction mixture was riped for 30 minutes. The obtained water gel polymer was taken out after reaction termination, and it cracked in the shape of a particle.

[0079] The cracked water gel polymer was dried at the bottom of a nitrogen air current, and 150 degree C for 1 hour using the hot blast circulation type dryer. Subsequently, it filtered, after mixing the ion-exchange-water 3000 section in this dry matter 1 section and stirring for 1 hour. After carrying out reduced pressure drying of the obtained filtration residue (water gel), the dry matter was ground using the table-top-type grinder. This obtained the magnesium salt of a powder-like bridge formation copolymer, i.e., the water retention material for plantation arts for a comparison. The liquid absorption scale factor of the obtained water retention material for plantation arts for a comparison was 19.2 g/g. With the main conditions at the time of manufacture of the water retention material for plantation arts for a comparison, the liquid absorption scale factor was indicated to Table 2.

[0080] Next, the engine performance of the water retention material for plantation arts for the above-mentioned comparison was evaluated under the same conditions as an example 1. Consequently, the germinating rate was 82%. Moreover, the growth situation is poor and the radish withered and died. These evaluation result was indicated to Table 3.

[0081]

[Table 1]

|     |   | アニオン性単量体         | ノニオン性単量体                                      | 単量体成分の<br>モル比 | 塩の種類    | 吸液倍率<br>(g/g) |
|-----|---|------------------|---|---------------|---------|---------------|
| 実施例 | 1 | メタクリル酸<br>ナトリウム  | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 9 モル)  | 67/33         | マグネシウム塩 | 15.9          |
|     | 2 | 同上               | 同上  | 67/33         | カルシウム塩  | 21.0          |
|     | 3 | 同上               | 同上  | 5/95          | カルシウム塩  | 17.2          |
|     | 4 | 同上               | 同上  | 95/5          | カルシウム塩  | 5.4           |
|     | 5 | アクリル酸<br>ナトリウム   | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 23 モル) | 80/20         | カルシウム塩  | 18.8          |
|     | 6 | メタクリル酸<br>ナトリウム  | ブトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 50 モル) | 80/20         | カルシウム塩  | 14.1          |
|     | 7 | メタクリル酸<br>マグネシウム | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 9 モル)  | 67/33         | マグネシウム塩 | 18.9          |
|     | 8 | メタクリル酸<br>カルシウム  | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 9 モル)  | 67/33         | カルシウム塩  | 63.0          |

[0082]

[Table 2]

|     |   | アニオン性単量体        | ノニオン性単量体                                     | 単量体成分の<br>モル比 | 塩の種類    | 吸液倍率<br>(g/g) |
|-----|---|-----------------|--|---------------|---------|---------------|
| 比較例 | 1 | メタクリル酸<br>ナトリウム | メトキシポリエチレン<br>グリコールメタクリレート<br>(平均付加モル数 9 モル) | 67/33         | ナトリウム塩  | 22.6          |
|     | 2 | アクリル酸<br>ナトリウム  | アクリルアミド                                      | 30/70         | ナトリウム塩  | 25.3          |
|     | 3 | アクリル酸<br>ナトリウム  | ——   | ——            | ナトリウム塩  | 3.8           |
|     | 4 | アクリル酸<br>マグネシウム | アクリルアミド                                      | 30/70         | マグネシウム塩 | 19.2          |

[0083]

[Table 3]

|     |   | 発芽率<br>(%) | 生育状況   |
|-----|---|------------|--------|
| 実施例 | 1 | 88         | 良好     |
|     | 2 | 100        | 良好     |
|     | 3 | 92         | 良好     |
|     | 4 | 94         | 良好     |
|     | 5 | 96         | 良好     |
|     | 6 | 96         | 良好     |
|     | 7 | 86         | 良好     |
|     | 8 | 98         | 良好     |
| 比較例 | 1 | 66         | 不良(枯死) |
|     | 2 | 58         | 不良(枯死) |
|     | 3 | 54         | 不良(枯死) |
|     | 4 | 82         | 不良(枯死) |

[0084] It turns out that the water retention material for plantation arts concerning this example has a high liquid absorption scale factor, therefore it excels in water retention, and excels in the compatibility over a vegetable root so that clearly from Table 1 and 3. On the other hand, although the water retention material for plantation arts for a comparison concerning the examples 1, 2, and 4 of a comparison has a high liquid absorption scale factor and it excels in water retention so that clearly from Table 2 and 3, it turns out that it is inferior to the compatibility over a vegetable root, and a sprout, rooting, growth, etc. are checked. Moreover, while the water retention material for plantation arts for a comparison concerning the example 3 of a comparison has a low liquid absorption scale factor and it is inferior to water retention in it, it turns out that it is inferior also to the compatibility over a vegetable root.

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[Translation done.]